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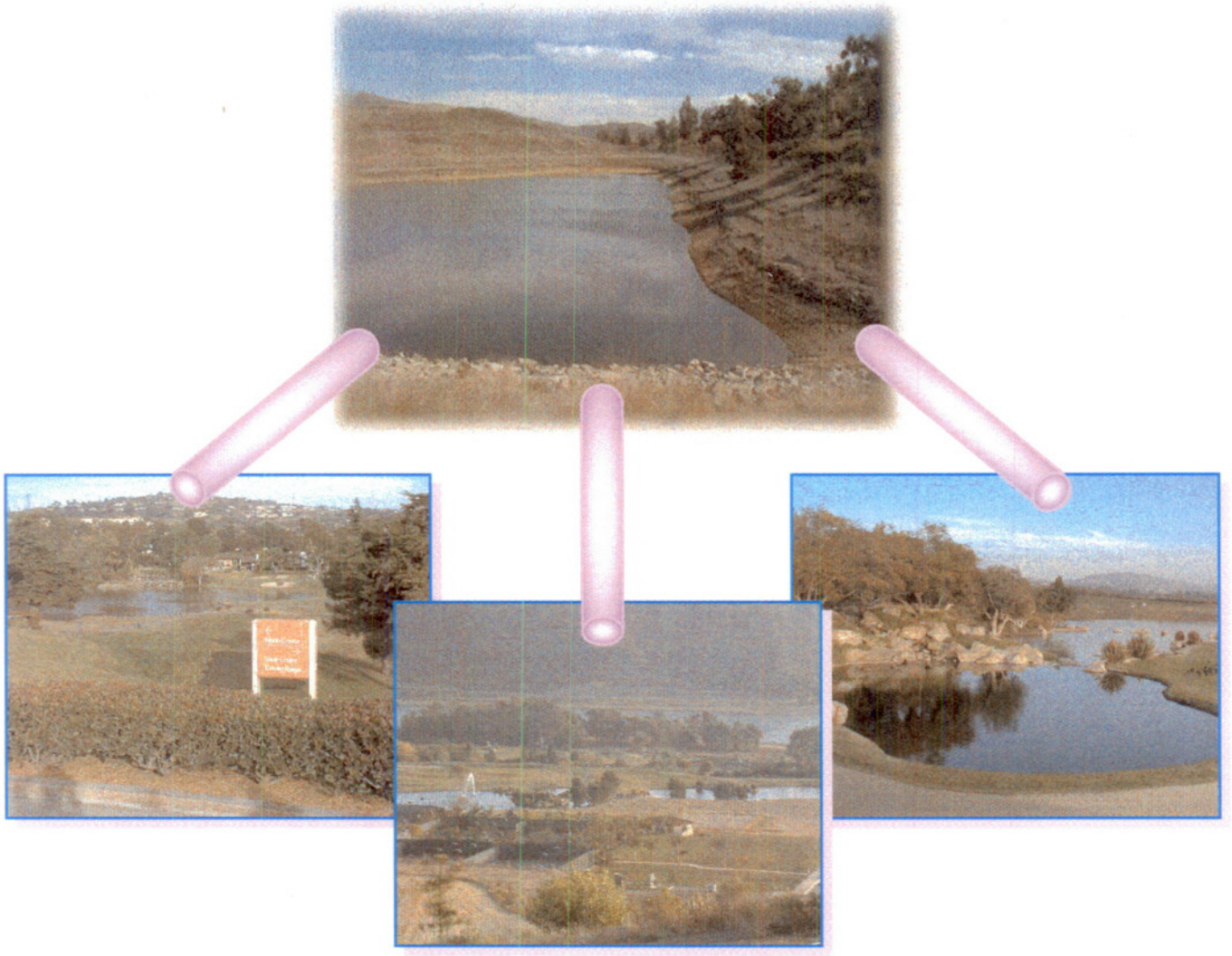

CARLSBAD MUNICIPAL WATER DISTRICT

Encina Basin Recycled Water Distribution System Study

CMWD No. 98-301

Powell Project Number 82.080

Prepared by

JOHN POWELL & ASSOCIATES, INC.

In Association with CGvL

POWELL

ENCINA BASIN RECYCLED WATER DISTRIBUTION SYSTEM

May 2000

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CHAPTER 1
INTRODUCTION

1.1 INTRODUCTION

The Carlsbad Municipal Water District (District) began serving recycled water within the Encina Basin in 1993. The Meadowlark Water Reclamation Facility (WRF) (owned and operated by the Vallecitos Water District) and the Gafner Wastewater Treatment Plant (WWTP) (owned and operated by the Leucadia County Water District) currently provide recycled water at a rate of 2 million gallons per day (MGD) and 0.75 MGD, respectively. The District's existing Phase I recycled water distribution system provides approximately 1,740 acre-feet per year (AFY) of irrigation water to approximately 20 users (120 meters). Major users include the Aviara Development and Golf Course, the La Costa Resort and Golf Course, and CALTRANS. Phase I recycled water demands currently exceed available supply.

The District's 1997 *Reclaimed Water Master Plan Update* identified a recommended Phase II recycled water system that will increase the peak supply from 2.75 MGD to 8.0 MGD. The Phase II expansion, described in the 1997 Master Plan Update, primarily included: constructing a new 4 MGD WRF near the existing Encina Water Pollution Control Facility (WPCF) and expanding the Meadowlark WRF by 1 MGD; constructing 74,000 feet of 12 to 24-inch distribution and transmission pipeline; and constructing a new recycled water pump station. Improvements to Mahr Reservoir for recycled water storage were also recommended.

Since 1993, the District has been constructing pipelines and requiring developers to install recycled water facilities in anticipation of the Phase II program and thus many existing potable water irrigation systems are ready to accept recycled water with little or no modification. Many of the proposed Phase II users are located adjacent to existing recycled water pipelines.

This Phase II Encina Basin Recycled Water Distribution System (Encina Basin RWDS) Study provides a detailed analysis of the existing recycled water distribution system hydraulics, the recommended Phase II recycled water distribution system, and Ultimate recycled water distribution system. In addition, this study provides predesign criteria for a new recycled water pump station and recycled water storage improvements. This study is also intended to satisfy the District's need for information required to complete the California Environmental Quality Act (CEQA) and the National Environmental Policy Act (NEPA) documentation for the Phase II project.

1.2 SCOPE OF WORK

This study identifies a recommended expansion of the existing recycled water distribution system, as well as a preliminary design of new recycled water pump stations and of improvements to existing reservoirs. The major scope of work elements for this project are summarized as follows:

- Market Assessment
- Design Criteria Evaluation
- Hydraulic Analysis
  - Existing System
  - Phase II/Ultimate System
  - Storage Analysis
- Pipeline Alignment Evaluation
- Pump Station Evaluations
- Reservoir Evaluations
- Engineering Cost Opinion
- CEQA Coordination

Expansion of the wastewater treatment plants that produce recycled water for the District is addressed in two separate reports prepared by Black & Veatch titled *Preliminary Design Report for the Carlsbad Water Recycling Facility*, January 2000 and *Expansion of the Meadowlark Water Reclamation Facility*, October 1999.

1.3 PROJECT OBJECTIVE

The basic approach to this study, coordinated with the District, was to confirm a realistic recycled water market, to assure a cost effective distribution system driven by the largest potential users, and to evaluate the most effective use of the District's existing recycled water infrastructure. To accommodate ultimate system planning, the Phase II backbone distribution system was sized to accommodate estimated capacity requirements of the Ultimate System recycled water demands. The primary study goal was to develop a recycled water distribution system plan for major recycled water facilities that will allow the District to move forward with the design, construction, and implementation of an expanded recycled water program.

1.4 AUTHORIZATION

The Encina Basin RWDS Study was authorized by the District on May 27, 1999. The contract was awarded to John Powell & Associates, in association with Cathcart Garcia von Langen (CGvL) Engineers.

CHAPTER 2
RECLAMATION PLANNING

This chapter describes the project study area and summarizes the District's previous water reclamation planning efforts.

2.1 STUDY AREA

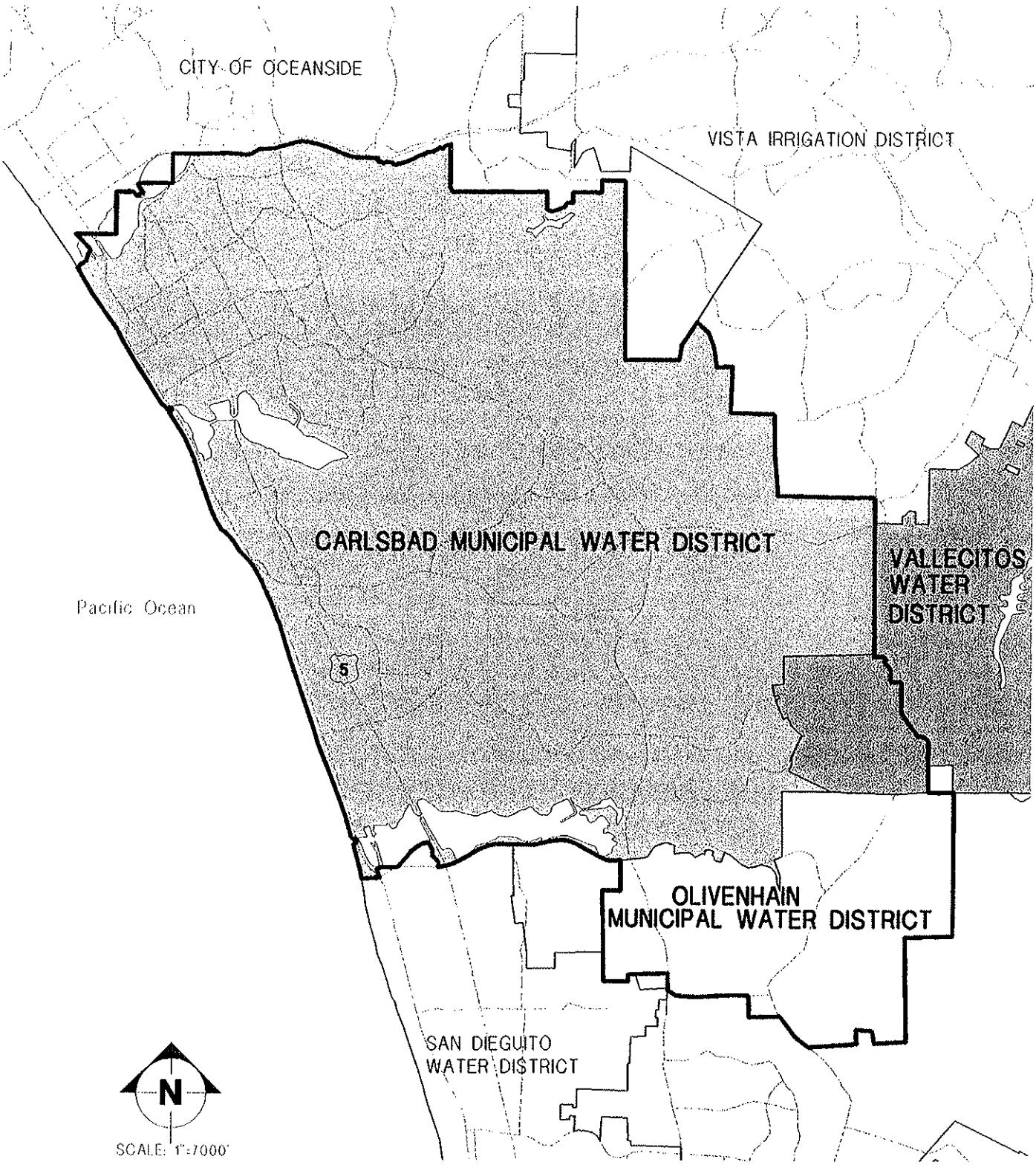
The Carlsbad Municipal Water District (District) is located in coastal, northern San Diego County and covers approximately 30 square miles within the City of Carlsbad. The District provides water, recycled water and sewer service to most of the City of Carlsbad. Other special districts serve the eastern portion of the City and include the Olivenhain Municipal Water District for water service, and the Leucadia County Water District and Vallecitos Water District for sewer service. The study area is shown on Figure 2-1.

The City of Carlsbad is bordered on the north by the City of Oceanside. To the east are the cities of Vista and San Marcos and to the south is the City of Encinitas. Wastewater collection and treatment is provided to the City of Carlsbad by numerous agencies. Wastewater treatment plants in the study area include Vallecitos Water District's Meadowlark WRF, Leucadia County Water District's Forest R. Gafner Wastewater Treatment Plant (WWTP), and Encina Joint Powers Agency's Encina Water Pollution Control Facility (WPCF). These treatment plants are existing or potential sources of recycled water. Their locations are shown on Exhibits D-1, D-3, and D-4 in Appendix D.

Land uses in the City of Carlsbad vary widely. Closer to the coast, Carlsbad is primarily residential with some business parks. Inland, Carlsbad includes agricultural users, some of which are being developed into residential areas. Some land uses that would benefit from irrigation with recycled water include commercial and industrial business parks, city parks and schools, agriculture, golf courses, and freeways. The District is already serving some of these areas. Existing and potential recycled water markets are discussed in Chapter 4.

2.2 PAST WATER RECLAMATION PLANNING

The District began planning for wastewater reclamation in 1978. There have been more than 20 reclamation planning documents prepared over the past 20 years that evaluated alternative reclamation projects for the District, including the use of regional facilities. In 1990, the District adopted an ordinance defining a recycled water use policy. In summary, the policy requires recycled water to be used wherever



LEGEND

——— CITY OF CARLSBAD BOUNDARY

WATER SERVICE AREAS WITHIN THE CITY OF CARLSBAD

FIGURE 2-1

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Mahr and Lake Calavera Reservoirs for seasonal and diurnal recycled water storage.

2.3 RECENT DEVELOPMENTS IN LOCAL RECLAMATION PLANNING

In the fall of 1999, pursuant to preliminary findings contained in Black & Veatch's report on the Carlsbad Water Recycling Facility, the District decided not to pursue the Meadowlark WRF expansion as part of the Phase II system. Instead, the District will increase the planned 4 MGD plant at Encina to 5 MGD, which is more economical than constructing an additional 1 MGD at the Meadowlark WRF.

Another recent development is an agreement between the Leucadia County Water District and the Carlsbad Municipal Water District to connect the Gafner WWTP directly to the District's recycled water distribution system (385 pressure zone). The Gafner WWTP will continue to directly serve the La Costa South Golf Course, and also provide recycled water directly into the District's recycled water distribution system.

CHAPTER 3
EXISTING WATER RECLAMATION SYSTEM

This chapter discusses the overall existing recycled water system, development and calibration of the existing system hydraulic model, and presents results of hydraulic simulations with maximum day demands on the system.

3.1 RECLAMATION PLANT SUPPLY AND CONVEYANCE

The District's existing Phase I recycled water system receives its supply from the Vallecitos Water District's Meadowlark Water Reclamation Facility (WRF) and Leucadia County Water District's Gafner Wastewater Treatment Plant (WWTP). The Gafner WWTP currently supplies recycled water only to the south golf course of the La Costa Spa and Resort. The main recycled water system is supplied entirely from Meadowlark WRF.

The Meadowlark WRF capacity is rated at 2.0 million gallons per day (MGD), however actual output is frequently less due to operational problems and constraints. District operators report that the plant output has recently been averaging about 1.7 MGD. Existing recycled water demands currently exceed the available supply during the summer and early fall necessitating supplemental water from the District's imported potable water supply system.

All recycled water from the Meadowlark WRF enters the existing distribution system from Vallecitos Water District's fail-safe gravity pipeline, which was originally constructed to convey effluent to the Encina Ocean Outfall for disposal. The effluent pump station at Meadowlark can discharge to either the Mahr Reservoir for storage or directly to the fail-safe pipeline. A 16-inch diameter return pipeline connects Mahr Reservoir to the fail-safe pipeline. Although water from Mahr Reservoir flows through micro screens before entering the return pipeline, water quality problems (odor and appearance) were frequently reported when the distribution system was being supplied from the reservoir. Because of these water quality problems, Mahr Reservoir is not currently used for storage.

3.2 DISTRIBUTION SYSTEM

The existing recycled water distribution system now has two connections to Meadowlark's fail-safe pipeline. The first connection is a minor turnout that supplies a portion of the La Costa Spa and Resort (north golf course) through a single 4-inch meter. Recycled water is discharged to a pond on the golf course,

where private irrigation pumps supply the on-site irrigation system. A review of recent meter records indicates that an average annual demand of approximately 240 acre-feet per year (AFY) is supplied from this connection. The main portion of the Phase I distribution system is supplied from the El Camino Pump Station.

El Camino Pump Station

Flow in Meadowlark's fail-safe pipeline is diverted to a small wet well at the El Camino Pump Station, located just east of El Camino Real near Camino Vida Roble. The El Camino Pump Station consists of three submersible pumps, two duty plus one stand-by, with a rated capacity of approximately 2 MGD with the two duty pumps operating. The pumps discharge directly into the Phase I distribution system at a hydraulic grade controlled by the water level in the D Tanks. A review of recent pumping data from the Supervisory Control and Data Acquisition (SCADA) system indicates that the discharge flow rate with one pump operating is approximately 950 to 1,250 gpm. With two pumps operating the discharge flow rate ranges from about 1,500 to 1,750 gpm.

The pumps are controlled to cycle on and off based on wet well water levels. Because of limited wet well capacity, the pumps cycle frequently. An overflow on the wet well discharges back to the fail-safe pipeline. When the D Tanks are full a high water level override signal sent to the pump station will also shut down the pumps. Since the quantity of recycled water produced at Meadowlark is adjusted to meet the projected daily demands, recycled water rarely overflows the wet well.

D Tanks

Two recycled water tanks (converted potable water reservoirs) located north of the Aviara development provide operational storage for the Phase I distribution system. The tanks are dimensionally identical, with a capacity of 1.25 million gallons each, bottom elevation of 384 feet, and wall height of 38.5-feet at the overflow, resulting in a high water level of approximately 423 feet. The tanks are connected hydraulically and both are typically in operation. In the event that the recycled water supply is insufficient to meet demands, supplemental potable water is supplied to the distribution system from a valve and air gap connection located at the D Tank site.

Potable Water Supply

Supplemental potable water is introduced to the recycled water system when the D Tanks reach a low water level. Potable water is supplied from an 8-inch diameter combination pressure reducing and sustaining valve. The current sustaining pressure setting on the potable water system is 50 psi. The potable water system pressure is usually above this setting, resulting in a flow rate to the D Tanks of about 2,000 gpm. During peak summer demands pressures in the potable water system will drop, and the sustaining valve will throttle and reduce the supply rate to the D Tanks.

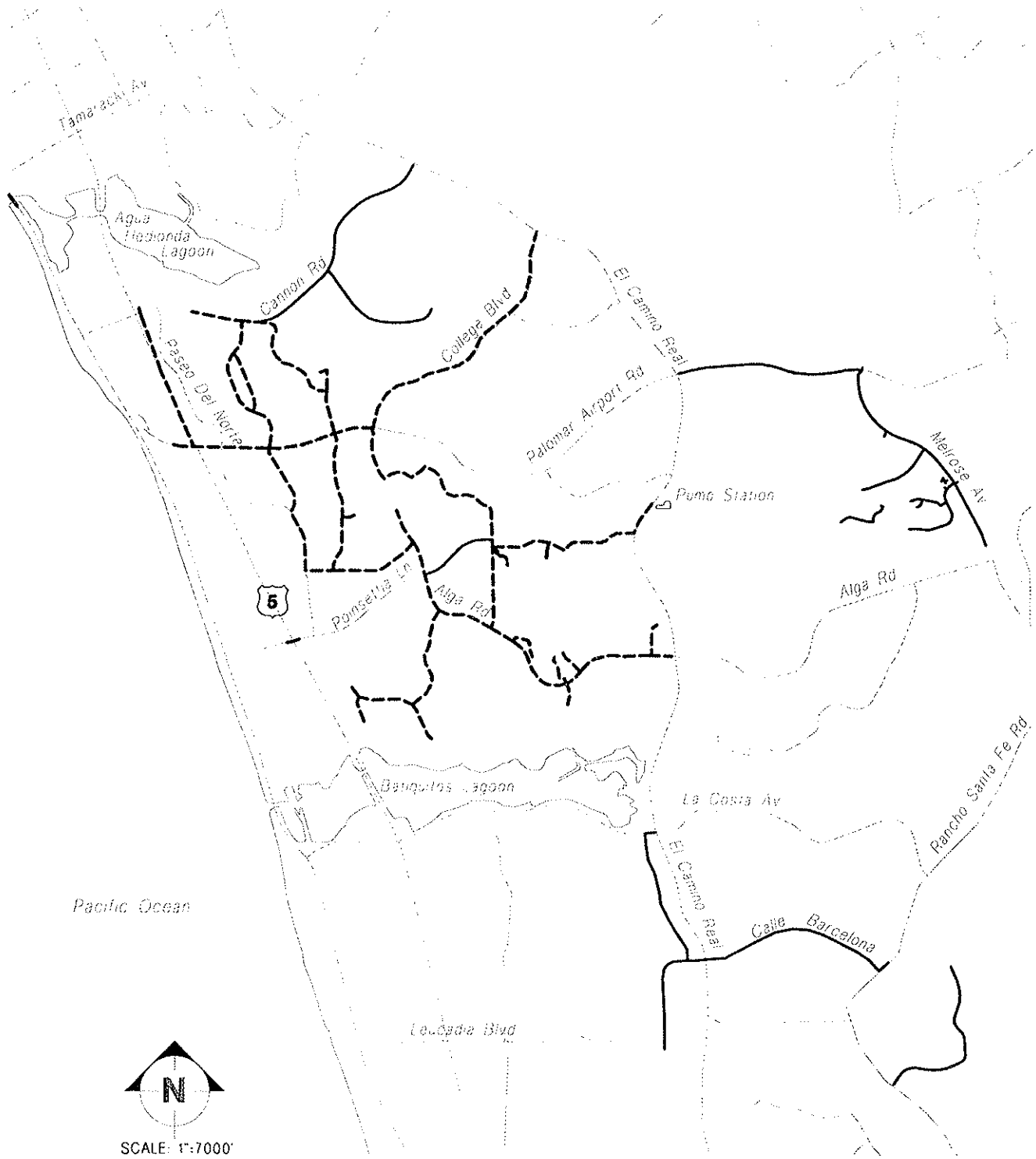
Distribution Pipelines

Pipelines considered part of the Phase I distribution system are illustrated in Figure 3-1. The pipelines range from 4- to 20-inches in diameter and include newer pipelines constructed specifically for the recycled water system, as well as older potable pipelines that can or have been converted for recycled water use. For approximately the past seven years new development projects with significant irrigation demands have been required to install separate recycled pipelines and irrigation meters. Many of these recycled water pipelines are currently supplied from the potable water system because of limited recycled water supply and/or the connecting recycled pipelines to the Phase I system have not yet been constructed. The current operational Phase I distribution system (energized pipelines only) is also identified in Figure 3-1.

Mahr Reservoir

Mahr Reservoir is an unlined, uncovered surface reservoir located south of the Meadowlark WRF. The reservoir is located within the City of Carlsbad corporate boundary and within the Olivenhain Municipal Water District (OMWD) service area. Mahr Reservoir was constructed in 1982 to provide 90 days of wet weather storage for Meadowlark WRF prior to constructing the land outfall. Appendix A includes a separate detailed investigation and analysis of Mahr Reservoir.

Mahr Reservoir has an estimated useful storage capacity of approximately 52 million gallons, which corresponds to a water surface elevation range of approximately 550 to 594 feet above mean sea level (msl). Due to algae growth in the reservoir, when used for recycled water storage, the District received numerous complaints from users regarding water quality. This condition persisted despite construction of a micro screening facility in 1994 to attempt to alleviate the problem. As a result, Mahr Reservoir is not currently used in the distribution system.



LEGEND

- RECYCLED PIPELINE CURRENTLY IN SERVICE
- PIPELINE IN GROUND, NOT IN SERVICE

EXISTING RECYCLED PIPELINES

FIGURE 3-1

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3.3 EXISTING DEMANDS

Based on billing account information provided by the District, approximately 120 meters are now supplied from the Phase I recycled water system. The existing recycled water customers, sorted from largest to smallest based on meter billing records, are listed in Table 3-1. The average annual demand supplied from the Meadowlark WRF, calculated from the District's 1998-99 billings, is 1,737 AFY or 1.55 MGD. The top five meters are owned by La Costa Hotel (2 meters), Aviara Master Association and Resort (2 meters) and the Four Seasons Resort (1 meter). These meters serve three golf courses, comprising over 50 percent of the total demand. Adding La Costa South Golf Course, which is supplied directly from Gafner WRP, brings the District's total average annual demand to approximately 2,200 AFY.

Based on the current recycled water supply rate of 1.7 MGD from the Meadowlark WRF (estimate provided from District operations) there would appear to be an average annual supply surplus of approximately 0.15 MGD (i.e. 1.7 MGD – 1.55 MGD). However, recycled water demands exhibit large seasonal variations and this calculated surplus cannot be utilized to supply peak summer demands without a large seasonal storage facility.

Monthly billing records for 1998 were reviewed to determine seasonal variation in demands. Figure 3-2 illustrates the monthly peaking factor based on these billing records. The highest average monthly demand was in July, with 2.2 times the average annual demand. Based on the current recycled water supply rate of 1.7 MGD, it is estimated that approximately half the system demands during the peak month were supplied with potable water. At the other extreme, the demand during February was only 0.12 times the average annual demand. This equates to a minimum month demand of slightly less than 0.2 MGD.

Figure 3-3 illustrates the recycled water supply surplus/deficit by month based on existing Phase I system demands. Based on the available supply rate from Meadowlark, a seasonal storage facility with a capacity of 162 MG, or roughly three times the size of Mahr Reservoir, would be required to completely eliminate the need for supplemental potable water in the existing system.

3.4 HYDRAULIC COMPUTER SIMULATIONS

A hydraulic computer model of the existing recycled water system was constructed using the H_2ONET (version 2.0) computer program and incorporating the demand data from Table 3-1. The model consists of the operational Phase I system starting at the El Camino Pump Station. After calibrating the model, extended period simulations were performed to determine if system deficiencies exist.

TABLE 3-1

EXISTING RECYCLED WATER CUSTOMERS AND AVERAGE ANNUAL DEMANDS

Meter #	Customer Name	Address	Meter Size (in)	Avg. Annual Demand (AFY)	(gpm)
96999-001	La Costa Hotel & Spa	Golf-Reclaimed W	4	236.86*	146.85*
96003-500	Aviara Master Assn	Alga Rd	6	222.97	138.24
96900-000	La Costa Hotel & Spa	Blk La Costa Ave	6	199.53	123.71
96001-600	Aviara Resort Assoc	Alga-Irr	6	175.98	109.10
96003-530	Four Seasons Resort	Alga/Four Seasons	6	82.50	51.15
96005-170	Legoland Estates	Lego Dr (No)Poc C	3	51.92	32.19
96002-101	Brehm Aviara Iii Dev	Aviara Prkwy - Rc	2	51.73	32.07
96870-530	Grand Pacific Resort	Armada Dr	2	45.91	28.47
96004-221	La Terraza Associates	Nicolia/Cassia	2	28.14	17.45
96005-160	Legoland Estates	Lego Dr (S0)Poc C	3	26.94	16.70
96541-501	City Of Carlsbad Parks	Hidden Valley Rd	3	25.61	15.88
96541-521	City Of Carlsbad Parks	Hidden Valley Rd	3	25.42	15.76
96870-130	Gemological Institute	Armada Dr -Irr	1½	22.62	14.02
96001-410	Aviara Land Assoc	Ambrosia Ln	2	21.62	13.41
96001-430	Aviara Land Associates	Ambrosia Ln	2	21.29	13.20
96870-800	Bernards Bros	Armada Dr	2	17.97	11.14
96690-351	Marbrisa Maint Corp	Sapphire Dr	1½	17.97	11.14
96870-230	Carlsbad Ranch Co Lp	Armada Dr - Ir	2	16.93	10.50
96881-020	City Of Carlsbad	Blk Poinsettia Ln	1	16.73	10.37
96005-401	State Dept Of Trans	Palomar Airport	4	15.73	9.75
96540-021	Mariners Point Hoa	Aviara Dr	2	15.62	9.68
96690-150	Greystone Homes	Cobblestone Rd	1½	14.56	9.03
96001-350	Carlsbad Unif School	Ambrosia	2	14.44	8.95
96001-300	Carlsbad Unif School	Ambrosia	2	14.38	8.92
96005-340	Craig Realty Group Llc	Paseo Del Norte	2	11.64	7.22
96870-530	Natl Assoc Music Merch	Armada Dr-Irr	1½	10.13	6.28
96870-530	Carlsbad Ranch Co Lp	Armada Dr	2	10.01	6.21
96541-440	Monarch Communities	Hidden Valley Rd	2	9.98	6.19
96005-250	Legoland Estates	Lego Dr (No Mtr)	3	9.22	5.72
96005-260	Legoland Estates	Lego Dr (So Mtr)	3	9.06	5.62
96003-100	Aviara Master Assoc	Kestrel Sta 33+09	2	8.96	5.55
96001-200	Aviara Master Assoc	Alga Rd	2	8.94	5.54
96001-420	Aviara Land Assoc	Ambrosia Ln	2	8.51	5.28
96690-000	Greystone Homes	Aviara Parkway	1½	8.38	5.20
96003-140	Aviara Master Assoc	Batiquitos Dr	2	8.09	5.02
96001-450	Aviara Master Assoc	Alga Rd -Irr	3	7.86	4.87
55-140	Cherry Tree Walk Llc	Aviara/Peppertree	3	7.84	4.86
96001-101	City Of San Jose	Alga/El Camino-Ir	1½	7.57	4.69
96541-481	Sea Bright Carlsbad	Hidden Valley Rd	2	7.50	4.65
96690-101	Mar Brisas Hoa	Cobblestone Rd	1½	7.46	4.63
96540-071	Seaside Estates Llc	Aviara	1½	7.41	4.59
96003-130	Aviara Master Assoc	Batiquitos Dr	2	6.94	4.30

* Demand is supplied directly from the fail-safe gravity pipeline and therefore is not included in the existing system model

TABLE 3-1 (continued)

EXISTING RECYCLED WATER CUSTOMERS AND AVERAGE ANNUAL DEMANDS

Meter #	Customer Name	Address	Meter Size (in)	Avg. Annual Demand (AFY)	(gpm)
96003-250	Aviara Master Assoc	Kestrel Sta 45+45	2	6.85	4.24
96541-470	Sambi Seaside Heights	Hidden Valley Rd	1½	6.81	4.23
96541-611	Seaside Heights Hoa	Robinea-Irr	1½	6.11	3.79
96003-201	Aviara Master Assoc	Kestrel Sta 20+90	2	6.04	3.74
96003-121	Isla Mar At Aviara Hoa	Batiquitos Dr	2	5.80	3.59
96004-150	Avocet Inc	C Alga	2	5.54	3.44
96540-121	Mariners Point Hoa	Cam De Las Ondas	2	5.31	3.29
96003-170	Aviara Master Assoc	Batiquitos Dr	2	5.31	3.29
96003-160	Aviara Master Assoc	Batiquitos Dr	2	5.21	3.23
96002-450	Aviara Master Assoc	Alga Rd-Irr	2	5.17	3.21
96003-151	Aviara Master Assoc	Kestrel Sta 20+84	2	4.90	3.04
96001-391	Aviara Seven Hoa	Sand Aster Dr	1½	4.81	2.98
96004-100	Aviara Master Assoc	B Alga Rd - Irr	2	4.60	2.85
96001-500	Aviara Master Assoc	Alga Rd-Irr	2	4.57	2.83
96004-000	Aviara Master Assoc	Batiquitos Dr-Irr	2	4.52	2.80
96003-061	Aviara Master Assoc	Batiq Reclaim	1	4.05	2.51
96001-380	Aviara Seven Hoa	Sand Aster Dr	1½	4.02	2.49
96002-500	Aviara Master Assoc	Alga Rd-Irr	2	3.96	2.45
96541-601	Udc Homes	Plum Tree Sta 30+	1½	3.73	2.31
96002-050	Aviara Master Assoc	Alga Rd-Irr	2	3.62	2.24
96001-371	Aviara Seven Hoa	Sand Aster Dr	2	3.57	2.21
96003-600	Aviara Master Assoc	Batiquitos Dr-Irr	2	3.49	2.16
96001-490	Barratt American Inc	Adolphia Pl	1½	3.48	2.16
96004-052	Tramonto Hoa	Batiquitos Dr-Ir	2	3.45	2.14
96004-700	Cmwd	Twin Tanks	1½	3.35	2.08
96540-041	Cherry Tree Walk	Aviara Pkwy	1½	3.25	2.02
96870-530	Denso Intl America Inc	Armada Dr	1½	3.25	2.01
96540-101	Mariners Point Hoa	Gold Flower Rd	2	3.14	1.94
96001-001	City Of Carlsbad-Libry	Alga/El Camino-Ir	1½	3.06	1.90
96002-400	Aviara Master Assoc	Alga Rd-Irr	2	3.04	1.88
96870-700	Carlsbad Ranch L.P.	Armada Dr	2	2.95	1.83
96005-150	Carlsbad Ranch Co	Hidden Valley Rd	2	2.89	1.79
96003-110	Aviara Master Assoc	Batiquitos-Ir	2	2.77	1.72
96002-150	Aviara Master Assoc	Alga Rd-Ir	2	2.71	1.68
96003-051	Aviara Master Assoc	Gabbiano Reclaim	1	2.64	1.64
96001-521	Aviara Seven Hoa	Adolphia Dr - Rc	1½	2.39	1.48
96001-900	Aviara Master Assoc	Alga Rd-Irr	2	2.27	1.41
96002-250	Aviara Master Assoc	Alga Rd-Irr	2	2.25	1.40
96003-071	Aviara Master Assoc	Gabbiano Ln	1	2.18	1.35
96001-981	Aldea At Aviara	Cormorant Dr - Ir	2	2.17	1.34
96003-091	Aviara Master Assoc	Batiquitos	2	2.13	1.32
96001-471	Aviara Seven Hoa	Baccharis Av	2	2.12	1.32
96001-941	Aldea At Aviara	Cormorant Dr - Ir	2	1.92	1.19

TABLE 3-1 (continued)

EXISTING RECYCLED WATER CUSTOMERS AND AVERAGE ANNUAL DEMANDS

Meter #	Customer Name	Address	Meter Size (in)	Avg. Annual Demand (AFY)	Avg. Annual Demand (gpm)
96001-052	City Of San Jose	Alga/El Camino-Ir	1½	1.90	1.18
96001-650	Aviara Master Assoc	Alga Rd-Irr	2	1.72	1.07
96690-251	Mar Brisas Hoa	Sapphire Dr	1½	1.71	1.06
96001-952	Aldea At Aviara Hoa	Cormorant Dr - Ir	2	1.70	1.05
96531-311	City Of Carlsbad Parks	Paseo Del Norte	1	1.58	0.98
96541-101	Poinsettia Cove M Grp	W/S Hidden N/Cdlo	1½	1.51	0.93
96001-461	Aviara Seven Hoa	Baccharis Ave	1½	1.45	0.90
96005-450	Islands Restaurant	Palomar Airport	1	1.43	0.89
96541-620	Sambi Seaside Hgts Llc	Plumtree/Hidden V	1	1.29	0.80
96001-971	Aldea At Aviara	Cormorant Dr - Ir	2	1.23	0.76
96001-961	Aldea At Aviara	Cormorant Dr - Ir	2	1.21	0.75
96540-060	Sambi Seaside Hts Llc	Aviara Sta 36+65	1	1.18	0.73
96001-511	Aviara Seven Hoa	Adolphia Dr	1½	1.11	0.69
96001-800	Aviara Master Assoc	Alga Rd -Irr	2	1.07	0.66
96690-300	Greystone Homes	Sapphire Dr	1½	1.04	0.65
96870-530	Natural Alternatives	Fleet St	1½	1.03	0.64
96001-700	Aviara Master Assoc	Alga Rd	2	1.00	0.62
96001-480	Barratt American Inc	Adolphia Dr	1½	0.97	0.60
96870-030	Carlsbad Ranch Co Lp	Cannon Sta 34+75	1	0.90	0.56
96001-250	Aviara Master Assoc	Alga Rd -Irr	2	0.83	0.52
96005-430	City Of Carlsbad	Sta 22+55 Cannon	1	0.81	0.50
96540-141	Carlsbad Unif School	Cam De Las Ondas	2	0.66	0.41
96002-000	Aviara Master Assoc	Alga Rd -Irr	2	0.62	0.38
96541-121	Poinsettia Cove M Grp	Hidden Vl N/Cdlo	1½	0.60	0.37
96002-200	Aviara Master Assoc	Alga Rd-Irr	2	0.58	0.36
96002-350	Aviara Master Assoc	Alga Rd-Irr	2	0.51	0.32
96002-300	Aviara Master Assoc	Alga Rd-Irr	2	0.51	0.32
96001-551	Aviara Resort Assoc	Alga-Irr	2	0.50	0.31
96005-300	Carlsbad Ranch Co Lp	Palomar Airport	1	0.49	0.31
96001-030	Postmaster	El Camino Real Rc	1½	0.46	0.29
96001-400	Aviara Master Assoc	Alga Rd -Irr	2	0.40	0.25
96005-500	Price Costco	Palomar-Median Ir	3/4	0.19	0.12
96001-151	City Of Carlsbad-Parks	Mananita/Alga	1	0.12	0.07
96004-201	La Terraza Associates	Cassia Rd / Ecr	1	0.08	0.05
96003-081	Aviara Master Assoc	E/Batq S/Gabbi Rc	1	0.01	0.01
96005-101	Carlsbad Ranch Co	E Tank	2	0.00	0.00
SUBTOTAL				**1737 AFY**	**1077 gpm**
	La Costa South GC *(supplied directly from Gafner WRP)*	La Costa Blvd/El Camino	4	447.90	277.70
TOTAL EXISTING RECYCLED WATER AVERAGE ANNUAL DEMAND				**1,354 gpm 2,185 AFY 1.95 MGD**	

FIGURE 3-2
RECLAIMED WATER DEMANDS BY MONTH
BASED ON 1998 BILLING RECORDS

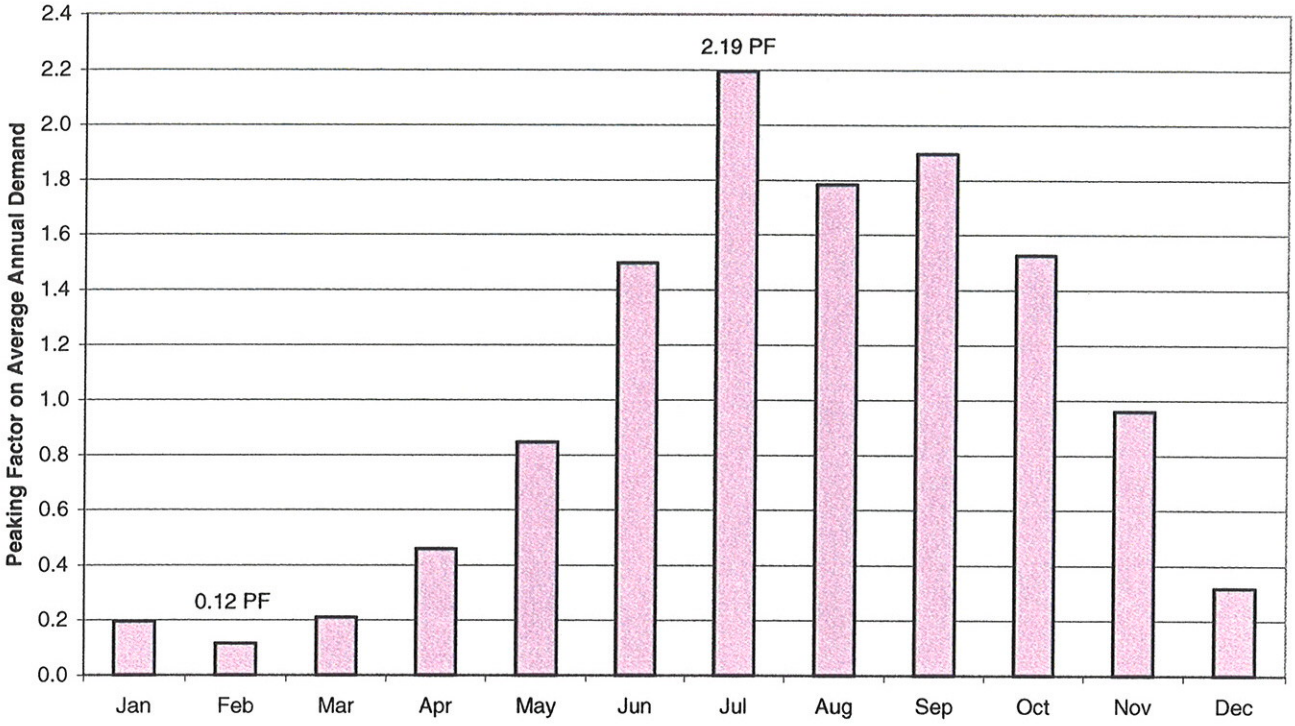
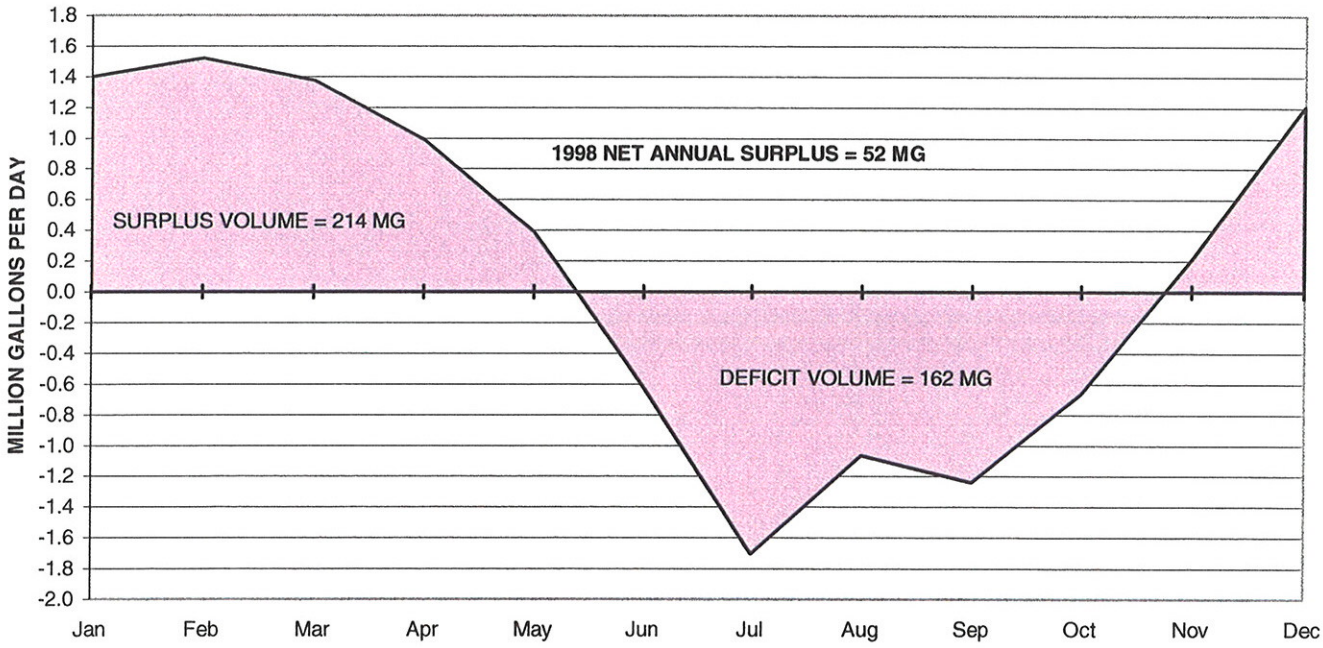


FIGURE 3-3
SURPLUS/DEFICIT RECYCLED WATER BASED ON 1998 DEMANDS
AND A CONSTANT SUPPLY RATE OF 1.7 MGD



Model Development

A base map consisting of street rights-of-way and land parcels was created in AutoCAD from the District's map book pages. The H_2ONET model was then digitized to identify current and potential recycled water customers, in an overlay to this base map. Pipeline diameters were obtained from the District's map book, and nodal elevations were input by overlaying the model with 2-foot contours obtained from the City of Carlsbad.

A map with existing recycled meter account numbers was provided by the District. These accounts were assigned to nodes in the model. Then a demand for each node was obtained using an Excel spreadsheet to calculate the average annual demands from District meter records. Individual pumps at the El Camino Pump Station were added to the model. The pumps were controlled by the level of the wet well and "D" tanks.

Model Calibration

Accuracy of the existing system model was verified by performing a 24-hour period hydraulic simulation and comparing model results with data collected in the field and documented on the SCADA system. The model was run with input values corresponding to distribution system conditions beginning at 12:00 noon on August 17, 1999. Data collected by the District during the calibration period included D Tank water levels, potable water supply rates, and pumping cycles at the El Camino Pump Station.

Figure 3-4 illustrates the 24-hour recycled water demand for this period. The demand averaged approximately 1,500 gpm, or 2.2 MGD and a peak hourly demand of approximately 4,000 gpm occurred at 1:00 AM. A demand of at least 200 gpm occurred throughout the day. From this chart it is apparent that the District mandated 10:00 PM to 6:00 AM irrigation period defined in the recycled water user agreement is not being strictly followed. During the calibration period, Meadowlark was experiencing operational problems and the supply rate was restricted to approximately 1.0 MG. One of the D Tanks was also out-of-service, limiting the volume of operational storage. As a result, the potable water system was required to supply 1.2 MG. Figure 3-5 illustrates the sources of supply to the system throughout that day.

An H_2ONET hydraulic simulation was performed by inputting the calculated hourly demand calibration factors and modeling the pump start/stop times obtained from the District's SCADA system. The D Tank starting water level was also input for the first hour of the simulation. An extended period simulation was then run for the 24-hour period, ending at 12:00 noon on August 18, 1999. Computed water levels for the D Tank were compared to actual levels and the results varied by less

FIGURE 3-4
CALCULATED RECYCLED WATER DEMAND ON AUG 17-18, 1999
(Excluding demand to La Costa Golf Course from the fail-safe pipeline)

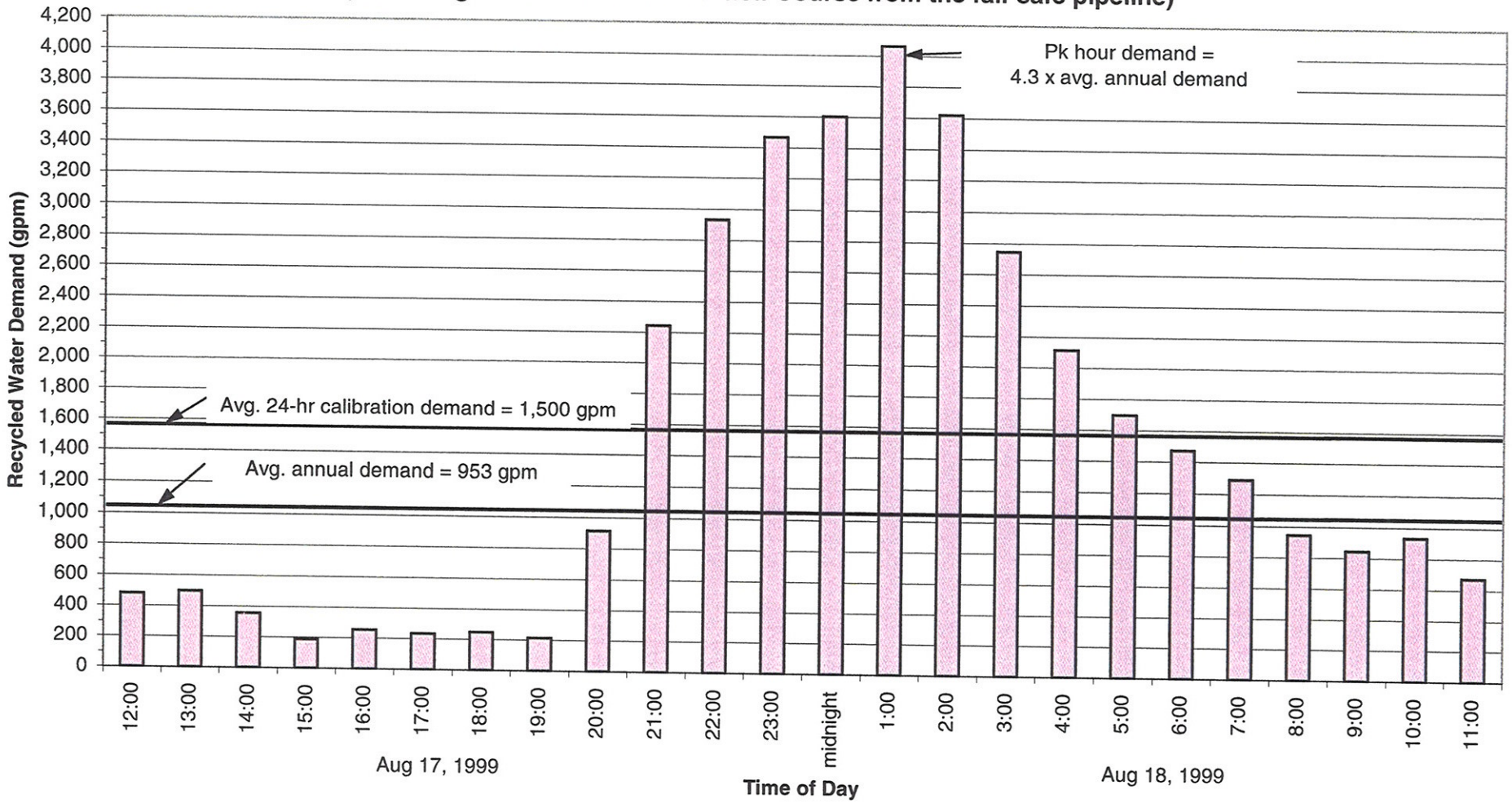
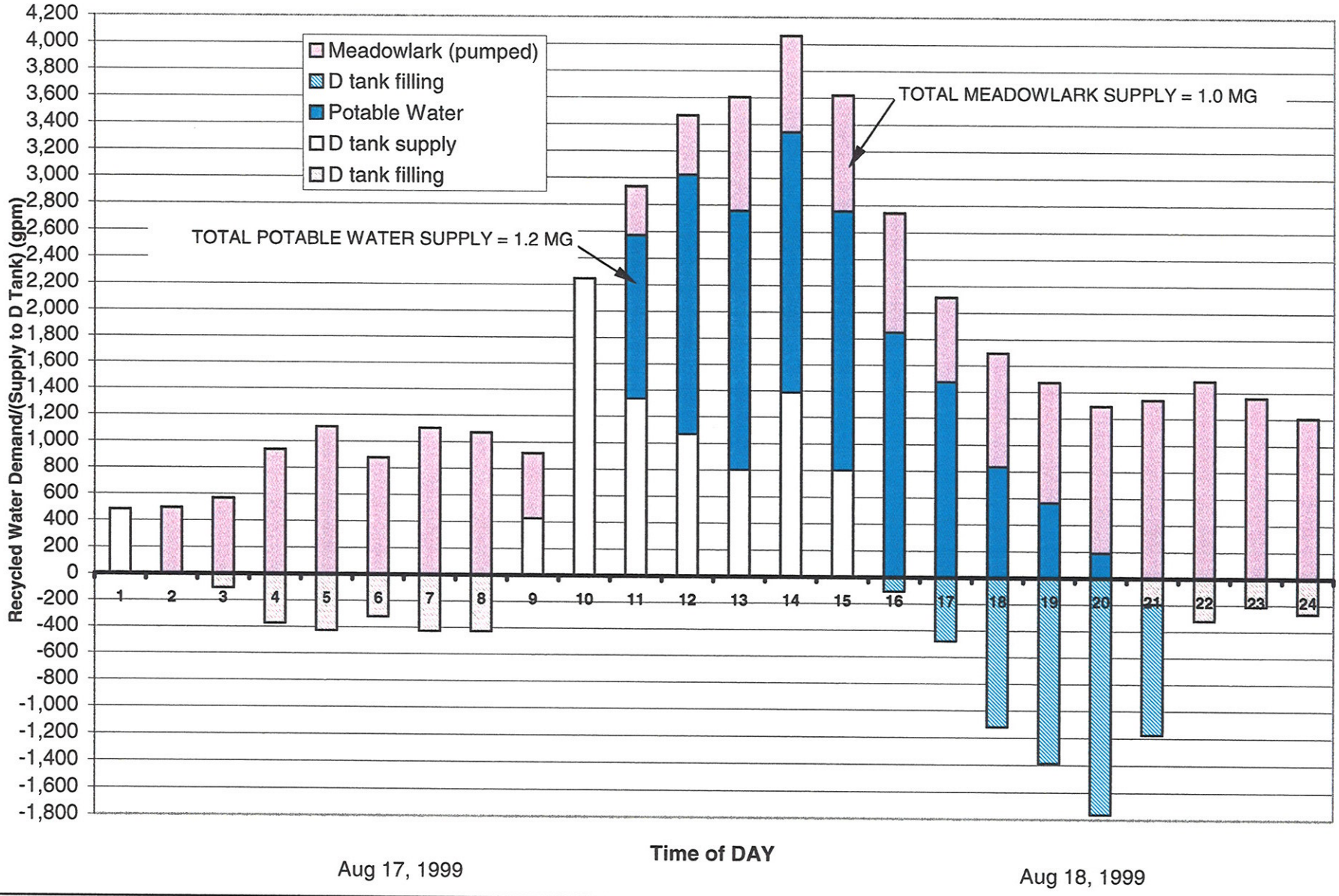


FIGURE 3-5
SOURCE OF SUPPLY DURING CALIBRATION PERIOD



than two feet during the simulation. Model pressures at various locations throughout the system also correlated well with pressure ranges reported by the operators. It was therefore concluded that the existing system H_2ONET model accurately represents the operational Phase I recycled water system.

Maximum Demand Simulation

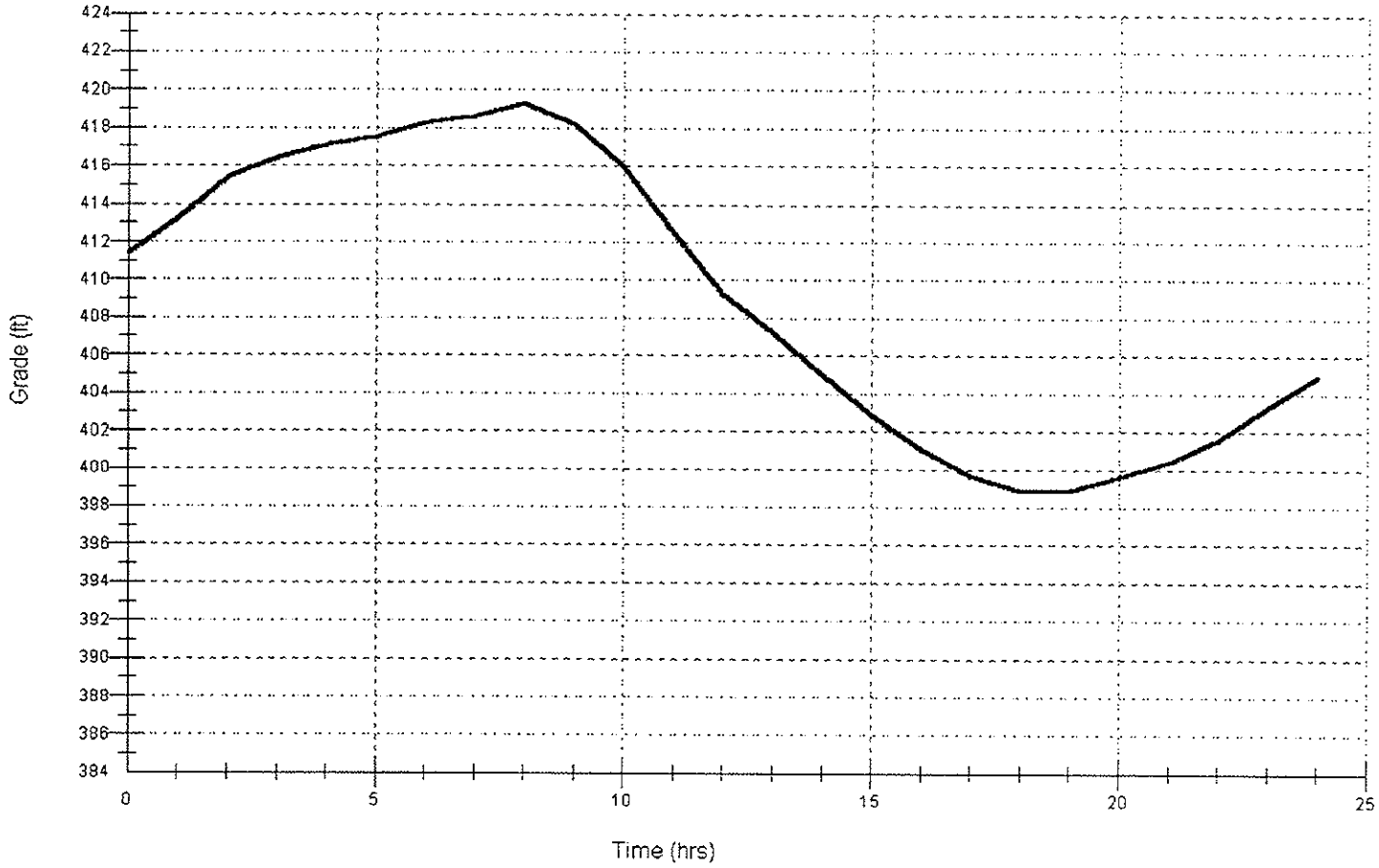
After calibrating the existing system model, it was modified to run a 24-hour simulation beginning at noon (hour 0) with maximum day demands. A diurnal demand curve with a peak hour factor of 6.0 and max day factor of 2.8 was developed for the existing system based on the calibration demand curve, a review of peak summer meter accounts, and peaking factors used for other similarly sized recycled water systems. A peak hour factor was not extrapolated directly from peak flows observed during calibration, since peaking relative to the daily average will typically be lower on the maximum demand day. During the hottest summer days, large users will tend to irrigate at the same flow rate for a longer period of time, thereby spreading out the irrigation demands and reducing the peak hour factor.

During the maximum day simulation, a constant flow rate of 1.7 MGD (1,180 gpm) was assumed entering the wet well from Meadowlark. Individual pumps at the El Camino Pump Station were then controlled based on current wet well level settings. Based on data obtained during the calibration period, the supplemental potable water supply rate was assumed at 1,955 gpm for the nighttime hours when high demands occur in the recycled water system. This flow was controlled based on the D Tank water level.

Summary of Results

Exhibit D-1 (Appendix D) illustrates analysis results (pipeline pressures and velocities) from the peak hour in the extended period simulation which corresponds to 1:00 AM. During the 24-hour simulation the potable water fill valve was open for a total of approximately 16 hours, supplying over 50 percent of the maximum day demand. Resulting water levels in the D Tank are shown on Figure 3-6. On the basis of this analysis it can be concluded that the D Tanks are marginally sized to provide operational storage for existing demands, assuming the full tank volume can be utilized. Highest pipeline velocities occur in the 10-inch diameter pipeline extending south from the D Tanks to Aviara Parkway. This pipeline supplies a peak hour flow of 2,300 gpm and has a velocity of over 9 feet per second. The high head loss in this pipeline results in low pressures (less than 20 psi) for the higher elevation areas within Aviara. The District has confirmed that irrigation demands in this area are supplied from private pumps. The area of Camino de las Ondas, between Briarwood Drive and Aviara Parkway, also experiences peak hour pressures below 20 psi primarily due to the high service elevations (static pressures less than 50 psi) and lack of system looping. Computer output from the maximum day existing system simulation is included in Appendix C.

FIGURE 3-6
D TANK LEVELS DURING EXISTING SYSTEM MAXIMUM DAY SIMULATION



CHAPTER 4
RECYCLED WATER MARKETS

4.1 INTRODUCTION

Existing recycled water markets within the City of Carlsbad were identified in Chapter 3. This chapter identifies potential recycled water markets that could be served with an expanded recycled water treatment and distribution system. Potential recycled water markets are locations where recycled water could replace potable water use. These potential markets are typically landscape or agricultural irrigation systems, or possibly industrial water users. This chapter discusses previous market assessments and current customer assessment including the results of an irrigation meter survey within the District, and recommended service areas for the Phase II and Ultimate distribution systems.

4.2 PREVIOUS ASSESSMENTS

In 1990, the *Carlsbad Reclaimed Water Master Plan* identified market types and then researched potential recycled water markets using past studies, water meter records, irrigation meter records, and assistance from the City's planning department. Market types included the following: agricultural, golf course, freeway, land development and park irrigation; industrial and commercial uses; groundwater recharge and lagoon and stream enhancement. Specific potential customers were listed, along with an estimate of recycled water use at that site.

Potential markets identified in the 1990 Master Plan were primarily sites requiring landscape irrigation. Approximately 6,000 AFY was projected for potential recycled water irrigation in 1995, and approximately 10,700 AFY was projected for 2015. Stream and lagoon enhancement and groundwater recharge were not considered to be viable projects in the 1990 Master Plan.

The 1997 Master Plan Update reviewed the previous assessment of potential recycled water markets. Planned land development had changed in some areas of Carlsbad; some markets identified in the 1990 Master Plan had been changed to designated open space for habitat management, and some potential markets no longer existed. However, the updated list of potential recycled water markets included 208 sites throughout the City, including Olivenhain Municipal Water District (OMWD), and projected an ultimate irrigation use of approximately 11,000 AFY, within 2.8 percent of the 1990 Master Plan projection. No use of groundwater recharge or stream/lagoon enhancement was addressed in the update.

4.3 CURRENT CUSTOMER ASSESSMENT

To define the Phase II and Ultimate distribution systems, an updated look at potential recycled water customers was required. Using the 1997 Master Plan Update list of potential and existing markets as a basis for the current assessment, the information was evaluated for accuracy. The accuracy of this information was also essential in developing an updated hydraulic model. The District also provided current recycled irrigation meter records (Table 3-1) for existing Phase I customers for evaluating average and peak month recycled water demands.

Typically, when estimating potable water demands, conservative estimates of water use are used in hydraulic analyses to provide for adequate system design capacity. However, in a recycled water distribution system, an overly conservative estimate of demand can adversely impact accomplishing the District's reuse goals and resultant revenues. Overestimating potential recycled water demands (acreages of irrigable area or irrigation application rates) must be avoided so that the District's reclamation program can succeed.

The District's preliminary financial analyses are based on recycled water sales of 5,000 AFY by the year 2008. Based on further financial analysis, it was determined that recycled water sales of 5,400 AFY is a more favorable goal and comfortably satisfies the SWRCB funding criteria. In addition, the District is participating in Metropolitan Water District of Southern California's (MWD) Local Resources Program (LRP), which requires reliable and achievable demand projections. Furthermore, overestimating potential demands, including peak usages, could result in oversized facilities and excessive capital cost. Therefore, an irrigation meter record survey was conducted to better assess the recycled water market and potential demand.

Irrigation Meter Record Survey

The District had previously maintained an AutoCAD drawing of each potable water meter location in its water system, which does not include the City area served by OMWD. The District updated this drawing and provided it in order to facilitate a detailed irrigation meter record survey. These data were converted into a Geographic Information System (GIS) coverages where each irrigation meter was graphically linked to its unique account number. The District then provided one year of potable irrigation records that was converted to an average annual demand for every irrigation meter.

Approximately 850 irrigation meter accounts were surveyed from the GIS coverage and linked database. Exhibit D-2 illustrates these meter locations throughout the District. The irrigation meters were then grouped into subareas throughout the District's service area to determine where the largest potential demand areas were

located. The software program "ArcCAD" was utilized to intersect the subareas with the meter accounts to provide an average annual demand for each subarea and a total District-wide demand, excluding the OMWD service area within the City.

In summary, the District currently serves approximately 3 MGD (3,300 AFY) of irrigation demand using potable water. Thus, if sufficient recycled water supply is available, the District could actually meet its Phase II goal by converting current irrigation services to the recycled system. However, in many cases these demands are located a long distance from the existing recycled system such that it is not cost effective to connect.

In reviewing the database, many irrigation meters serve a low annual demand that may not be economical to convert from potable to recycled water. It is also possible that some existing landscape areas may not wish to use recycled water due to stringent water quality requirements. For example, despite recycled water being currently available at these developments, irrigation meters at both Aviara and La Costa developments were connected to the potable system, due possibly to water quality or other onsite requirements. Some flower growers also require very high quality water that may only be achievable through further onsite treatment of recycled water. For these reasons, it is recommended that the District design its Phase II recycled water system to serve a potential demand of at least 10 to 15 percent over the revenue goal of 5,400 AFY.

Comparison to Previous Assessments

In reviewing the previous market assessments, several customers appeared to have overestimated demands when compared to actual irrigation usage. For example, the potential recycled water demand at the Olympic Resort and Hotel was previously estimated based on an irrigated area of 130 acres. Based on existing potable irrigation records and site reconnaissance (the irrigation is used for a driving range, not a golf course), the actual irrigated area appears to be less than 10 acres, which correlates to the actual demand of approximately 15 AFY. (Previous estimates were about 400 AFY.)

The Rancho Carlsbad Golf Course, located along El Camino Real showed a low potable irrigation use for the approximate 35 acre site. District staff confirmed that groundwater is used for onsite irrigation, resulting in the current low potable demand. This user may be reluctant to convert to recycled water use due to economics, presuming the cost to pump groundwater is much less than recycled water costs. Because of the high potential demand (over 100 AFY), the District should ultimately consider this site for recycled water. For study purposes, the market assessment included this site, as an ultimate customer, with a demand of 100 AFY.

Summary of Key Findings

It became apparent, based on the potable irrigation meter survey, that the following subareas within the District provided significant potential recycled water demand:

- Calavera Hills (100 AFY)
- Carlsbad Research Center (125 AFY)
- Homeowner Associations just east of Interstate 5 (100 AFY)
- Carrillo Ranch (Continental Homes) (200 AFY)
- District Office Area (150 AFY)

These areas were generally in close proximity to existing recycled pipelines or have already been dual plumbed to accept recycled water. Thus, these areas became primary target service areas for the Phase II distribution system. Those customers (typically residential developments) that were constructed after 1993, have been dual plumbed, as required by the District. These potential recycled water customers are expected to be served as soon as recycled water becomes available and should be a priority for designing the Phase II distribution system. No significant retrofitting of these proposed customers is expected to be required.

The irrigation meter database includes a number of meters with relatively low irrigation usage (less than 5 AFY). For example, the City of Carlsbad had over 20 irrigation meters that recorded an average water use of about 0.30 AFY, each. Although many of these meters were included in the hydraulic computer model, mostly because proposed recycled pipelines could easily serve these meters, it may not be cost effective to connect these smaller users to recycled water use unless they only require a simple service lateral connection.

As previously noted, the irrigation meter database contained over 850 meters. It was beyond the scope of services to contact and research every irrigation meter account. However, a few observations on the database are noted below. District staff should attempt to reconcile these issues during implementation of the Phase II program.

- La Costa Hotel & Spa had two different meter accounts with the same average demand (113.106 gpm). It should be verified that these accounts are separate meters, and not a record-keeping duplication.
- The customer "San Diego Specialty" had three meter accounts, coincidentally, with the same demand (14.382 gpm). These accounts should also be verified.
- The District office had a significant demand, equal to 150 AFY (95.4 gpm), that should be confirmed.
- There appears to be a few duplicate entries, although the demand is low, that should be reconciled.

- Continental/Carrillo Ranch had a significant existing irrigation demand for this master planned community. New developments may be required to temporarily irrigate to establish re-vegetation, thus showing a much higher demand in the early years. This information may only be available from the master-developer as to the extent of permanent irrigation. As part of the design phase to extend facilities to Carrillo Ranch, the District, with the developers, should review their best estimate of long-term future demand.

As discussed in the next section, the Phase II model assumes that all the potable water irrigation meters will be converted. Accordingly, a higher Phase II potential demand is used to allow for some contingency for potable irrigation meters that may not connect to the recycled system.

4.4 PROPOSED PHASE II CUSTOMERS

To satisfy conditions of financial assistance from MWD's LRP, the District is required to sell approximately 5,400 AFY of recycled water by 2008. The existing recycled water system serves approximately 2,000 AFY (including La Costa Golf Course (South) which receives recycled water directly from the Gafner WRF); therefore the Phase II distribution system must reach enough customers to satisfy an additional recycled water demand of approximately 3,400 AFY. This equates to approximately 1,400 acres of irrigated landscape area assuming an application rate of 2.5 AFY per acre. In the District's efforts to expand recycled water use, it also becomes desirable to target recycled water service areas that extend beyond the District boundary, including the OMWD service area, within the City of Carlsbad.

To begin the Phase II market evaluation, the list of all potential recycled water customers from the 1997 Master Plan Update was reviewed and updated. Projected demands were revised for existing customers on the list that are now being served with potable water based on recent irrigation meter data. A few additional customers were also added based on a review of recent development plans.

Initially, a distribution system was proposed that would expand the existing recycled water pipeline network and serve all potential recycled customers. This distribution system was then optimized, creating a Phase II system that would meet the re-use goal with a minimum number of new recycled water facilities. The proposed Phase II Recycled Water System, which is presented in Chapter 5, was then refined by investigating several different pipeline alternatives, hydraulic computer simulations, and incorporating comments from the District.

Potential customers served from the Phase II recycled water system are listed in Table 4-1 by magnitude of demand. The first column of Table 4-1 lists an identification number corresponding to the customer number assigned in the 1997 Master Plan Update. Locations of these customers are also illustrated on Exhibit D-2 in Appendix D. The corresponding customer node number is listed in the last column of Table 4-1 and the node locations are shown on the hydraulic model pipe and node map for Phase II, Exhibit C-2. When compiling the total acre-feet per year of recycled water usage for the Phase II customers, the actual, rather than estimated, irrigation usage was used, if it was available. In Table 4-1, approximately 3,200 AFY of additional recycled water demands are identified for the Phase II distribution system, not counting the potable irrigation meter survey. Approximately 400 AFY of the potential Phase II demand is located within the OMWD area.

The largest potential customers for the Phase II system are identified as follows:

- Carlsbad Municipal Golf Course (385 AFY)
- Kelly Ranch (216 AFY)
- La Costa Residential Areas (170 AFY and 177 AFY, the Ridge and Oaks)
- Green Valley (155 AFY).
- Calavera Hills (additional 100 AFY)

These customers represent major land development projects under construction or anticipated to be under construction over the next two years. These five largest users within the Phase II system, listed above, represent over 40 percent of the potential demand on the expanded distribution system. Therefore, the financial success of the Phase II program will greatly depend on the full development of these larger customers. In reviewing Table 4-1, the District also should focus on developing recycled water customer demands in excess of 50 AFY in the early years of the Phase II program because they represent more than 75 percent of the estimated potential demand.

Referring to Table 4-1, a potential demand of approximately 900 AFY was included from the potable irrigation meter survey. This demand represents irrigation meter locations along existing or proposed Phase II recycled pipelines. Table B-1 in Appendix B summarizes the customer name and demand for these meters. In reviewing this table, it becomes apparent that multiple irrigation meters exist for the same customer or site. By grouping those meters, Table 4-2 presents a summary of the larger irrigation users currently being served by the potable system. Through grouping, these customers become a high priority for conversion to recycled water.

TABLE 4-1
PHASE II RECYCLED WATER CUSTOMERS

Customer No. (1)	Press. Zone	Market Name	User Type	Irrigated Acreage	Unit Demand Factor (AF/Ac/Yr)	Projected Avg. Annual Demand (AFY)	Model Node No.
G-01	384	Carlsbad Municipal Golf	Golf Course	120.0	3.20	384.0	1080
R-23	384	Kelly Ranch	Landscape	86.6	2.50	216.5	1152
C-08	550	Carlsbad Research Center	Landscape	--	--	202.2 (2)	2024
R-22	540	Residential	Landscape	76.0	2.50	190.0	5004
R-46	550	Residential	Landscape	72.0	2.50	180.0	2056
R-56	*384*	*La Costa Res. (Oaks)*	*Landscape*	*71.0*	*2.50*	*177.5*	*1190*
R-53	550	La Costa Residential - NE	Landscape	68.0	2.50	170.0	2074
R-55	*384*	*Green Valley (Ridge)*	*Landscape*	*62.0*	*2.50*	*155.0*	*1190*
R-48	660	Carrillo Ranch	Landscape	42.0	2.50	105.0	3012
R-68	384	Macario Canyon	Landscape	42.0	2.50	105.0	1096 — 1150
C-11	550	Industrial Center	Landscape	41.3	2.50	103.1	2040
R-37	550	Residential	Landscape	34.4	2.50	86.0	2002 —
R-46	384	Residential	Landscape	34.0	2.50	85.0	1169
R-14	540	Residential — Poinsettia	Landscape	34.0	2.50	85.0	5008
P-10	384	~~Alta Mira~~ Community Park	Landscape	33.6	2.50	84.0	1070
S-16A	384	High School	Landscape	20.0	3.75	75.0	1064
R-49	660	Carrillo Ranch	Landscape	23.0	2.50	57.5	3022
R-32	384	Residential	Landscape	20.0	2.50	50.0	1210
A-11	550	Steindorf	Agricultural	24.0	2.00	48.0	2042
C-04	384	Industrial	Landscape	18.8	2.50	46.9	1082
G-03	384	Taylor Made Golf	Golf Facility	24.7	1.75	43.2	1110
C-07	550	College Business Park	Landscape	16.5	2.50	41.3	1104
S-15C	384	Junior High	Landscape	10.0	3.75	37.5	1064
S-15B	*384*	*Junior High*	*Landscape*	*10.0*	*3.75*	*37.5*	*1190*
P-14	660	Carrillo Ranch Park	Landscape	14.8	2.50	37.0	3030 — 3022
A-10	550	La Costa Wholesale Flowers	Agricultural	18.0	2.00	36.0	2050
R-29	550	Laurel Tree	Landscape	12.2	2.50	30.5	2010
R-38	384	Harbor Point Homes	Landscape	11.4	2.50	28.5	1210
C-13	660	Industrial Center	Landscape	10.5	2.50	26.3	3014
C-19	660	Planned Industrial	Landscape	10.0	2.50	25.0	3014
R-40	384	Vista Pacific	Landscape	9.6	2.50	24.0	1210
S-14D	*384*	*Elementary School*	*Landscape*	*6.0*	*3.75*	*22.5*	*1192*
S-14H	384	Elementary School	Landscape	6.0	3.75	22.5	2004
A-09	384	Fernandez Flowers	Agricultural	11.0	2.00	22.0	1198
C-14	384	Callaway Golf	Landscape	8.4	2.50	21.0	2012
S-11	550	La Costa Meadows El.	Landscape	5.1	3.75	19.1	2066
R-34	550	Vista Del Mar	Landscape	7.0	2.50	17.5	1112
R-35	384	Ocean Bluff	Landscape	6.2	2.50	15.5	2002
P-19	384	Zone 19 Park	Landscape	5.0	3.00	15.0	1028
G-07	550	Olympic Resort and Hotel	Golf Course	--	--	14.3 (2)	2042
R-51	660	Meadowcrest Res	Landscape	5.6	2.50	14.0	3020
I5ROW1	264	I-5 ROW	Landscape	5.0	2.50	12.5	4030
L-25	550	Fuerte	Landscape	3.6	3.00	10.8	2066
C-05	264	Occidental Land	Landscape	3.6	2.50	9.0	4024
P-12	384	Special Use Area	Landscape	3.2	2.50	8.0	1200
R-39	384	Seacrest	Landscape	2.8	2.50	7.0	1210
Total of Future Recycled Customers						**3203 AFY**	
Estimated Demands Based on Existing PW Irrigation Meters						**887 AFY**	
Existing Recycled Water Demands						**2185 AFY**	
TOTAL PROJECTED PHASE II DEMANDS						**6275 AFY** **5.6 MGD** **3890 gpm**	

(1) Per 1997 Recycled Master Plan
(2) Demand obtained from existing potable water meter records
Olivenhain MWD Customers shown in italics

TABLE 4-2
PHASE II SUMMARY OF LARGE POTABLE WATER IRRIGATION CUSTOMERS

Customer	Average Annual Irrigation Demand (AFY)
Carrillo Ranch (Continental Ranch)	213
Carlsbad Municipal Water District	153
Carlsbad Research Center	125
Calavera Hills	100
San Diego Specialty	60
Carlsbad Crest HOA	35
Alta Mira HOA	30
Upland Industries Corporation	30
OVLC Management Company DBA	20
Callaway Golf	20
Las Playas HOA	14
Western Pacific Homes	11

4.5 ULTIMATE CUSTOMERS

Table 4-3 provides detailed information regarding known recycled water customers that can be served by the Ultimate System, which is presented in Chapter 6. Many of these water customers are ready to be connected to the recycled water system now. However, due to Phase II pipeline routing economics, some of these customers are better served in the Ultimate System. A few potential customers were also eliminated from the distribution system due to their remote location, and associated high incremental cost of connecting pipelines.

The Ultimate System will serve an additional 4,000 AFY of recycled water within the City of Carlsbad, for a total recycled demand of approximately 10,000 AFY. The largest customers within the Ultimate System include the future Carlsbad Ranch Golf Course (400 AFY), La Costa Residential areas (372 AFY), and the Carlsbad Oaks Industrial Park (228 AFY). Another 300 AFY of potential demand was also identified within the OMWD service area. Approximately 1,000 AFY of potable irrigation meters were identified as potential recycled water customers. Table B-2 summarizes these meter accounts, customers, and demand.

TABLE 4-3
ULTIMATE RECYCLED WATER CUSTOMERS

Customer No. (1)	Press. Zone	Market Name	User Type	Irrigated Acreage	Unit Demand Factor (AF/Ac/Yr)	Projected Avg. Annual Demand (AFY)	Model Node No.
G-06	384	Carlsbad Ranch GC	Golf Course	72.0	3.20	400.0	1090
R-47	384	La Costa Residential - NW	Landscape	149.0	2.50	372.5	1218
C-12	660	Carlsbad Oaks Industrial	Landscape	91.2	2.50	228.0	3006
--	384	Bressi Ranch	Landscape	50.0	2.50	125.0	1224
--	660	Bressi Ranch	Landscape	50.0	2.50	125.0	3000
C-10	380	Palomar Airport Business Park	Landscape	45.0	2.50	112.5	2044
G-02	384	Rancho Carlsbad CC	Golf Course	35.0	3.20	112.0	1156
P-16	***550***	***Stagecoach Park***	***Landscape***	***26.0***	***3.00***	***78.0***	***2078***
S-16	***550***	***High School***	***Landscape***	***20.0***	***3.75***	***75.0***	***2080***
R-67	550	Residential	Landscape	28.0	2.50	70.0	3006
R-24	384	Evans Point	Landscape	25.6	2.50	64.0	1156
--	660	Carlsbad Raceway Business Park	Landscape	25.0	2.50	62.5	3044
R-44	264	SAMMIS PH. I	Landscape	24.1	2.50	60.3	4066
R-75	550	***Village of La Costa***	***Landscape***	***23.0***	***2.50***	***57.5***	***2078***
R-57	***550***	***La Costa Sur***	***Landscape***	***22.2***	***2.50***	***55.5***	***2082***
R-31	264	Alta Mira Residential	Landscape	20.0	2.50	50.0	4010
L-22/L-23	550	Safety Center (Landscape & Turf)	Landscape	15.0	3.00	45.0	2038
R-77	264	Poinsettia Shores Residential	Landscape	15.0	2.50	37.5 (2)	4064
C-09	550	Carlsbad Airport Center	Landscape	--	--	34.9 (2)	2102
R-52	550	Alga Hills	Landscape	--	--	20.7 (2)	2132
R-60	***550***	***Vista Santa Fe-C***	***Landscape***	***11.8***	***2.50***	***29.5***	***2082***
--	660	Palomar Forum	Landscape	10.0	2.50	25.0	3042
I-01	264	SDG&E	Landscape	10.0	2.50	25.0	4022
R-43	264	SAMMIS PH. III	Landscape	10.0	2.50	25.0	4042
C-16	***550***	***Commercial***	***Landscape***	***10.0***	***2.50***	***25.0***	***2078***
C-17	550	McClellan Palomar Airport	Landscape	1.0	2.50	25.0	2044
R-13	540	Calavera Cape	Landscape	9.0	2.50	22.5	5030
C-03	264	Industrial	Landscape	9.0	2.50	22.5	4012
S-12	***550***	***La Costa Heights Elem***	***Landscape***	***6.0***	***3.75***	***22.5***	***2078***
S-13	***550***	***Mission Estancia Elem.***	***Landscape***	***6.0***	***3.75***	***22.5***	***2082***
S-14G	384	Elementary School	Landscape	6.0	3.75	22.5	1032
C-02	264	Shaw, Talbot, etc	Landscape	7.5	2.50	18.8	4018
R-62	***550***	***Vista Santa Fe-B***	***Landscape***	***7.1***	***2.50***	***17.7***	***2080***
R-10	540	The Villas Residential	Landscape	6.0	2.50	15.1	5020
R-9	540	Calavera (The Crest) Residential	Landscape	5.2	2.50	13.0	5020
R-58	***550***	***Parkview Dev.***	***Landscape***	***5.2***	***2.50***	***13.0*** (2)	***2078***
C-06	384	Poinsettia Village	Landscape	--	--	12.8 (2)	4030
P-09	264	Cannon Park	Landscape	3.4	2.50	8.4	4022
R-50	550	Meadowcrest Res	Landscape	3.3	2.50	8.3	2098
L-21	264	Palomar Triangle	Landscape	3.0	2.00	6.0	4018
L-19	264	Cannon Industrial Park	Landscape	1.7	3.50	6.0	4020
L-20	264	Car Country	Landscape	0.8	3.50	2.8	4008
L-29	***550***	***Rancho Santa Fe Rd***	***Landscape***	***1.2***	***2.00***	***2.4***	***2078***
R-75	550	La Terrazo Housing	Landscape			24.3	2076
Total of Future Recycled Customers						**2601 AFY**	
Estimated Demands Based on Existing PW Irrigation Meters						**1062 AFY**	
Existing and Phase II Recycled Water Demands						**6275 AFY**	
TOTAL PROJECTED ULTIMATE DEMANDS						**9938 AFY 8.9 MGD 6161 gpm**	

(1) Per 1997 Recycled Master Plan
(2) Demand obtained from existing potable water meter records
Olivenhain MWD Customers shown in italics

4.6 RECYCLED WATER CUSTOMER DATABASE

A recycled water customer database has been developed to assist District staff in implementing the Phase II expansion. Microsoft's Access program was used for database construction. Information from the District and previous customer database construction for other agencies were examined to determine the appropriate data to be integrated within this relational database. While the major design and programming of the database is complete, the District will be able to customize and alter the database to suit evolving needs.

Examples of the current recycled water customer database are available in Appendix B. Included in these examples are switchboards, input forms, and output reports. Switchboards are simply menu selection screens allowing the program user to easily navigate through the available database forms and reports. These switchboards are graphical interfaces that allow a user to execute a more complex task by the click of a button. Input forms, which a program user will see when entering information, contain those fields in which data are entered into the database. Current design of the input forms can easily be altered to incorporate other desired data fields or to delete unneeded fields. Output reports are organized collections of data useful for generating hardcopy reports, reference information, or input files for other analyses. The Use Summary and Network Modeling Data reports are two examples of output reports designed for this database. These output reports can also be altered to more effectively meet the District's needs as they evolve.

The heart of the database, generally unseen by the program user, is comprised of data tables. These tables contain all data fields comprising the data record for each recycled water customer service. The fields contain alphabetic, numeric, and check-box information. In the current database design, 75 fields are available for each customer service record. As the District's system expands, the database could ultimately contain thousands of customer records. A given customer may have several service records, depending on its number of recycled water meters. Each service record is assigned a unique database identification number by the program, starting at "0001," that is used to maintain information relationships within the database.

Data for all District recycled water customers currently online have been entered into this database. These data include information developed from distribution system hydraulic network modeling, and from current District billing records. Information entered into the database can be used to project future conditions. Water use data from the database can be exported to the network model, by the above-noted output report, and used to generate hydraulic information that can then be imported back to the database. Using this tool, the District will have access to a wider range of information on recycled water customers, enabling staff to make informed decisions on expansion as well as to tackle ongoing operational concerns.

CHAPTER 5
PHASE II DISTRIBUTION SYSTEM

The Phase II distribution system is designed to deliver the recycled water use goal of 5,400 AFY by the year 2008 with the lowest feasible construction costs. The water sales target for the Phase II system is fixed by MWD's LRP loan conditions. Facility capital costs necessary to meet this sales target are a function of District budget constraints and the extent of potential financial assistance under a state loan program application that is in progress. With these sales and budget constraints in mind, several alternative Phase II systems were evaluated and presented to the District before the final system was recommended, based on cost efficiency, demand served and land development timing. Distribution facility sizes (pipelines, pump stations and storage tanks) are recommended based on results from computer hydraulic simulations performed with peak summer demands.

5.1 RECYCLED WATER DEMANDS AND PEAKING FACTORS

Phase II distribution system potential demand includes all customers currently served from the existing recycled water system plus existing irrigation meters now supplied from the potable water system, and potential users along proposed transmission mains. A list of Phase II customers was provided in Table 4-1. The average annual demand for all potential customers in the Phase II system is projected at 6,275 AFY. For the reasons discussed in Section 4.3, it is recommended that the Phase II system be designed for a potential demand greater than the reuse goal of 5,400 AFY to provide an appropriate contingency should some of the larger users not fully develop.

The Phase II distribution system must be sized to deliver peak summer flows, which are substantially higher than the average annual demand. Based on a review of existing recycled water billing records, demand variations observed during the model calibration process, and design peaking factors used by other recycled water agencies, peaking factors were established for the maximum month, maximum day and peak hour conditions. Peaking factors and projected Phase II demands are provided in Table 5-1.

TABLE 5-1
PHASE II AVERAGE AND PEAK RECYCLED WATER DEMANDS

Demand Condition	Peaking Factor	Potential Phase II Demand	
		(AFY)	(gpm)
Average Annual	1.0	6,275	3,891
Max Month	2.2	13,805	8,559
Max. Day	2.5	15,688	9,726
Peak Hour	6.0	37,650	23,343
Min. Month	0.15	941	584

5.2 RECYCLED WATER SUPPLY

Existing Phase I and Proposed Phase II Recycled Water Systems will receive recycled water supply from Meadowlark WRF, Encina WPCF, and Gafner WWTP. Each reclamation plant's projected capacity is shown in table 5-2.

TABLE 5-2
PHASE II RECYCLED WATER SUPPLY

Water Reclamation Plant	Phase II Capacity		
	MGD	AFY	gpm
Encina	5.0	5,599	3,472
Gafner	1.0	1,120	694
Meadowlark	2.0	2,240	1,389
Total	**8.0**	**8,959**	**5,556**

The District, parallel to this study, has completed a study of water reclamation plant expansion needs. Originally, the District planned to expand Meadowlark WRF from 2.0 to 3.0 MGD and construct 4.0 MGD of capacity at the Encina WPCF. From a preliminary design report being prepared by Black and Veatch for Meadowlark and Encina, the District has decided to pursue a larger Encina Facility and no expansion of Meadowlark at this time.

In comparing Phase II demands with existing and planned supply it is apparent that the recycled water supply will be insufficient to meet peak summer demands. The combined production of the reclamation plants is approximately 1.7 times the annual reuse goal of 5,400 AFY. Conservatively, if all potential Phase II demand is realized (6,275 AFY), the reclamation plants will produce only 1.7 times the annual demand. Since the peak month factor is 2.2, seasonal storage supplied from Mahr Reservoir and/or the potable water system will be required to meet summer demands. Figures 5-1 and 5-2 illustrate the projected monthly demands and recycled water supply deficit based on Phase II demands of 5,400 AFY and 6,275 AFY, respectively. These figures show that supplemental potable water will be required even when utilizing the full storage capacity of Mahr Reservoir.

FIGURE 5-1
PHASE II PROJECTED MONTHLY DEMAND AND SUPPLY SOURCES
Average Annual Demand = 5400 AFY

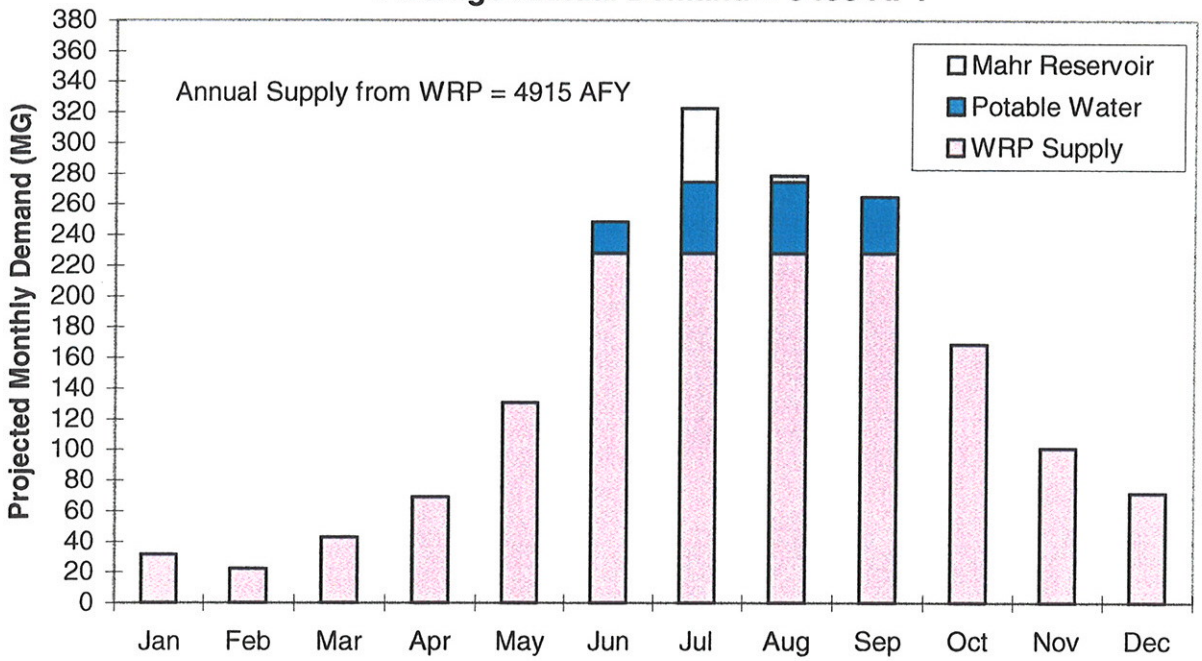
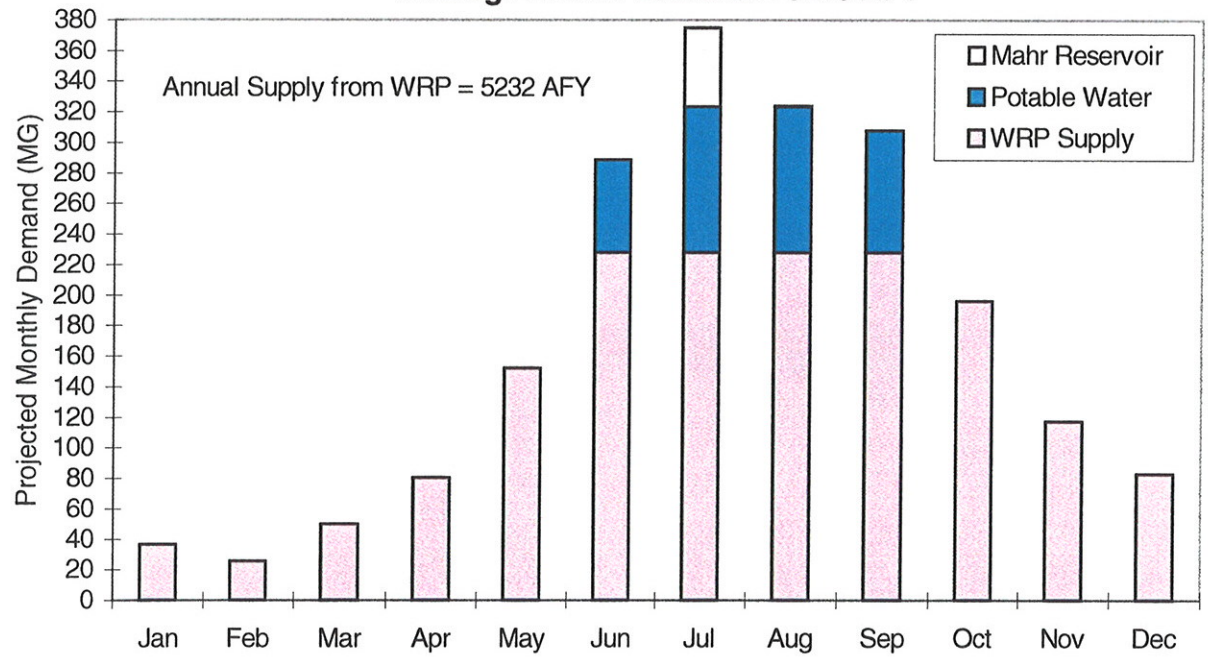


FIGURE 5-2
PHASE II POTENTIAL MONTHLY DEMAND AND SUPPLY SOURCES
Average Annual Demand = 6275 AFY



5.3 DISTRIBUTION SYSTEM PRESSURE ZONES

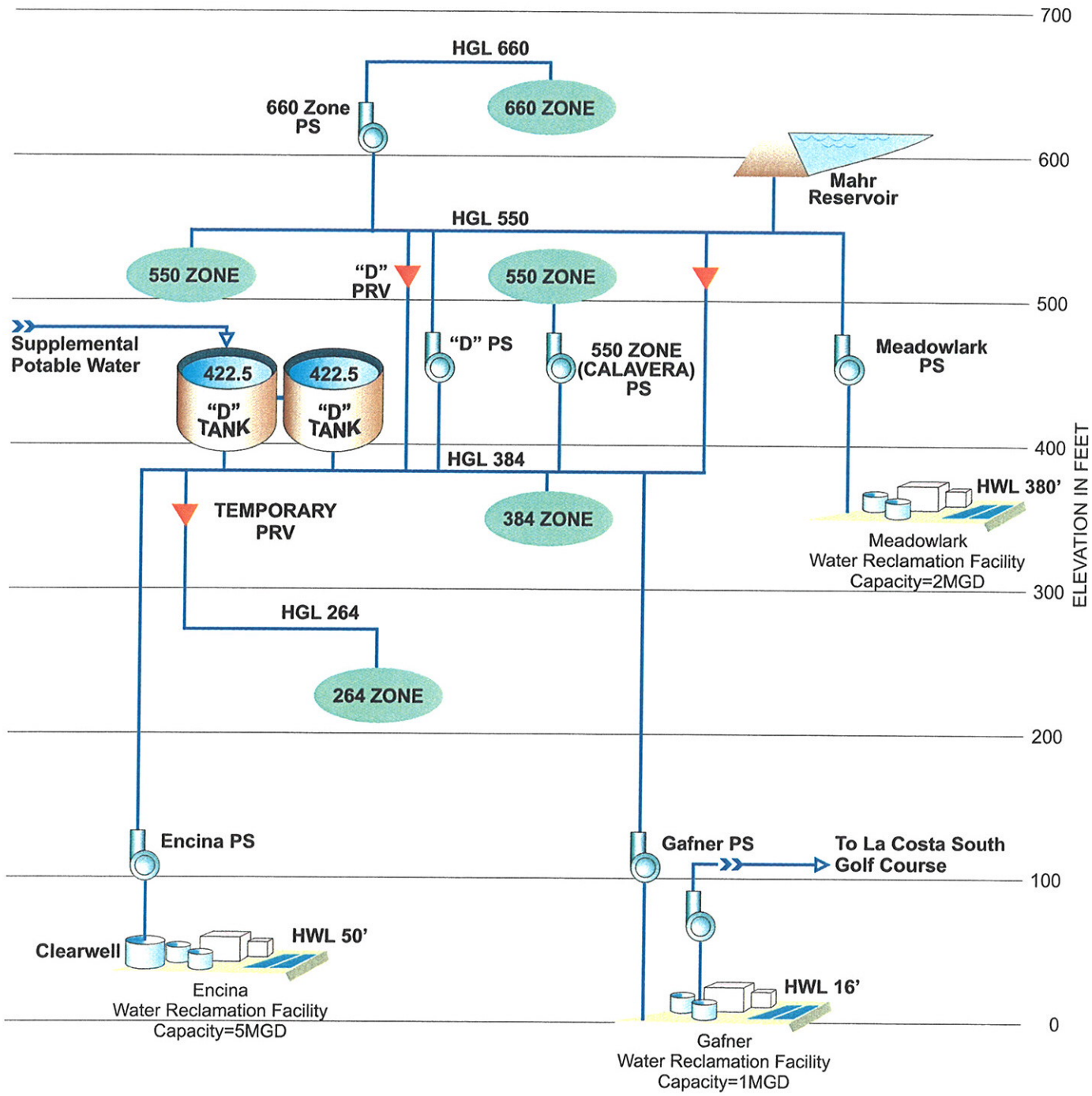
Pressure zones for the Phase II distribution system were developed around existing water storage facilities and are consistent with 1997 Master Plan Update recommendations. Five separate pressure zones are planned, which are referred to as the 384, 550 (Calavera), 550 and 660 Zones based on the bottom elevation of existing or future storage facilities. The 384 Zone is based on the low water level of the existing D Tanks. Based on typical distribution system design pressure ranges the next desirable pressure zones are generally 150 feet higher or lower. Thus a 550 Zone would serve well as the next higher zone in the Phase II system.

A Phase II distribution system schematic illustrating how each pressure zone is supplied is provided in Figure 5-3. The 384 Zone incorporates the D Tanks and existing recycled water distribution system plus proposed transmission and distribution pipelines. This zone, which is currently supplied from the El Camino Pump Station via the failsafe pipeline, will be supplied from pump stations at the Encina WPCF and the Gafner WWTP in the Phase II system. The El Camino Pump Station will then be abandoned because the failsafe pipeline will no longer be used to convey reclaimed water and Meadowlark WRF will supply the 550 Zone directly.

The 550 Zone serves higher elevations to the east of the 384 Zone. The 550 Zone hydraulic grade will be set by the water level in Mahr Reservoir, which will normally vary from 555 to 593 feet. Supply to the 550 Zone will be from the Meadowlark WRF and Encina WPCF, via a proposed pump station to be located at the D Tank site.

The Calavera Hills development, which is currently under construction and will extend College Boulevard to El Camino Real, is a significant Phase II demand that can be served by a closed zone, pumped to a 550 Zone directly from the 384 Zone. A separate study currently being conducted by the developer will determine the required discharge head to supply the critical high points within the development.

The 260 Zone generally serves those coastal areas west of Interstate 5. This is the lowest zone which was recommended by the District because service from the existing 384 Zone would result in delivery pressures exceeding 150 psi. District operators of the potable system serving this area have experienced service and meter leaks when system pressures exceed 150 psi. A portion of the 260 Zone will be connected to the recycled water system in Phase II. It will be served from the 384 Zone via a temporary pressure reducing station. Ultimately, the 260 Zone will be pumped from the Encina WRF and utilize the "E" Reservoir.



LEGEND

422.5 RESERVOIR, H.W.L.

PUMP STATION

PRESSURE REDUCING STATION

NOTE: HGL'S AND PRESSURE ZONES ARE BASED ON LOW WATER LEVELS OF TANKS.

PHASE II SYSTEM SCHEMATIC

FIGURE 5-3

Portions of the La Costa Villages future development (La Costa Ridge) will require additional pumping from the 550 Zone. It is recommended that the District consider a private booster pumped system to serve the proposed development. The 660 Zone will be a closed pumped zone (no storage) in the Phase II system. A proposed booster pump station near the intersection of El Camino Real and Palomar Airport Road will supply this zone from the 550 Zone. In the Ultimate System, the 660 Zone will be expanded to incorporate the Santa Fe Tank. Table 5-3 lists projected Phase II demands within each pressure zone.

TABLE 5-3
POTENTIAL PHASE II DEMANDS BY PRESSURE ZONE

Pressure Zone	Avg Annual Demand (AFY)	Avg Annual Demand (gpm)	Max Day (gpm)	Peak Hour (gpm)
384	3,237	2,007	5,017	12,040
260	60	37	94	225
550 (Calavera)	281	174	436	1,046
550	1,640	1,017	2,542	6,102
660	610	378	945	2,268
Total	**5,828**	**3,613**	**9,034**	**21,680**

Note: Demands do not include the La Costa South Golf Course, which is supplied directly from the Gafner WRP

5.4 RECLAMATION PLANT PUMP STATIONS

Encina Pump Station

The proposed Encina Pump Station will pump treated plant effluent from the Encina WPCF to the 384 Zone. For the Phase II system it is assumed that the pumps will typically supply a constant flow rate over a 24-hour period, with a maximum flow rate of approximately 3,500 gpm (5 MGD). It is recommended that storage be constructed under Phase II at Encina for the dual purpose of providing a clearwell for plant operations and a forebay, which would allow the pumps to operate at a constant discharge rate or adjust pumping rates based on the peak irrigation periods. This clearwell can also provide Phase II supply storage in the event of a process upset.

It is anticipated that the recycled water production rate at Encina will be adjusted on about a weekly basis to match system demands based on water levels in Mahr Reservoir. It is further anticipated that there will be periods during the winter months when supply from Encina is not needed (low demands and Mahr Reservoir full or near full), therefore the Encina Pump Station may, at times, be shut down.

Meadowlark Pump Station

The effluent pump station at the Meadowlark WRF will pump directly to the 550 Zone, as opposed to discharging to the fail-safe pipeline as is now done in the existing recycled water system. Based on a review of the existing pump curves, it appears that modifications to the pumps for Phase II operations will not be required. The discharge head would be controlled by Mahr Reservoir water level.

District staff have stated that recycled water production costs at the Meadowlark WRF are expected to be lower than production costs at Encina. Energy costs at the Meadowlark Pump Station will also be lower than at Encina since less lift is required. For these reasons it is anticipated that the pump station at Meadowlark will usually operate at or near plant capacity and function as the primary supply source. During low demand periods, supply from Meadowlark could supply the Phase II system utilizing the proposed pressure reducing station at the D Tank site. The exception being, the La Costa South Golf Course which would continue being supplied by Gafner WWTP.

Gafner Pump Station

In the Phase II recycled water system, pipelines will connect Gafner WWTP with the main distribution system. A portion of supply from Gafner will still be pumped directly to the La Costa South Golf Course and a separate pump station will be constructed to pump directly into the 384 Zone. It is assumed this work would be performed and funded by LCWD as part of the treatment plant expansion currently underway at Gafner. The flow rate from the new pump station is expected to vary with the recycled water production rate at Gafner and La Costa South Golf Course demands. An average supply rate of 350 gpm (0.5 MGD) into the main distribution system was assumed in the Phase II system analysis. The District may want to curtail recycled water production at Gafner during winter months to maximize supply from Meadowlark WPCF based on recycled water production costs.

5.5 RECYCLED WATER STORAGE FACILITIES

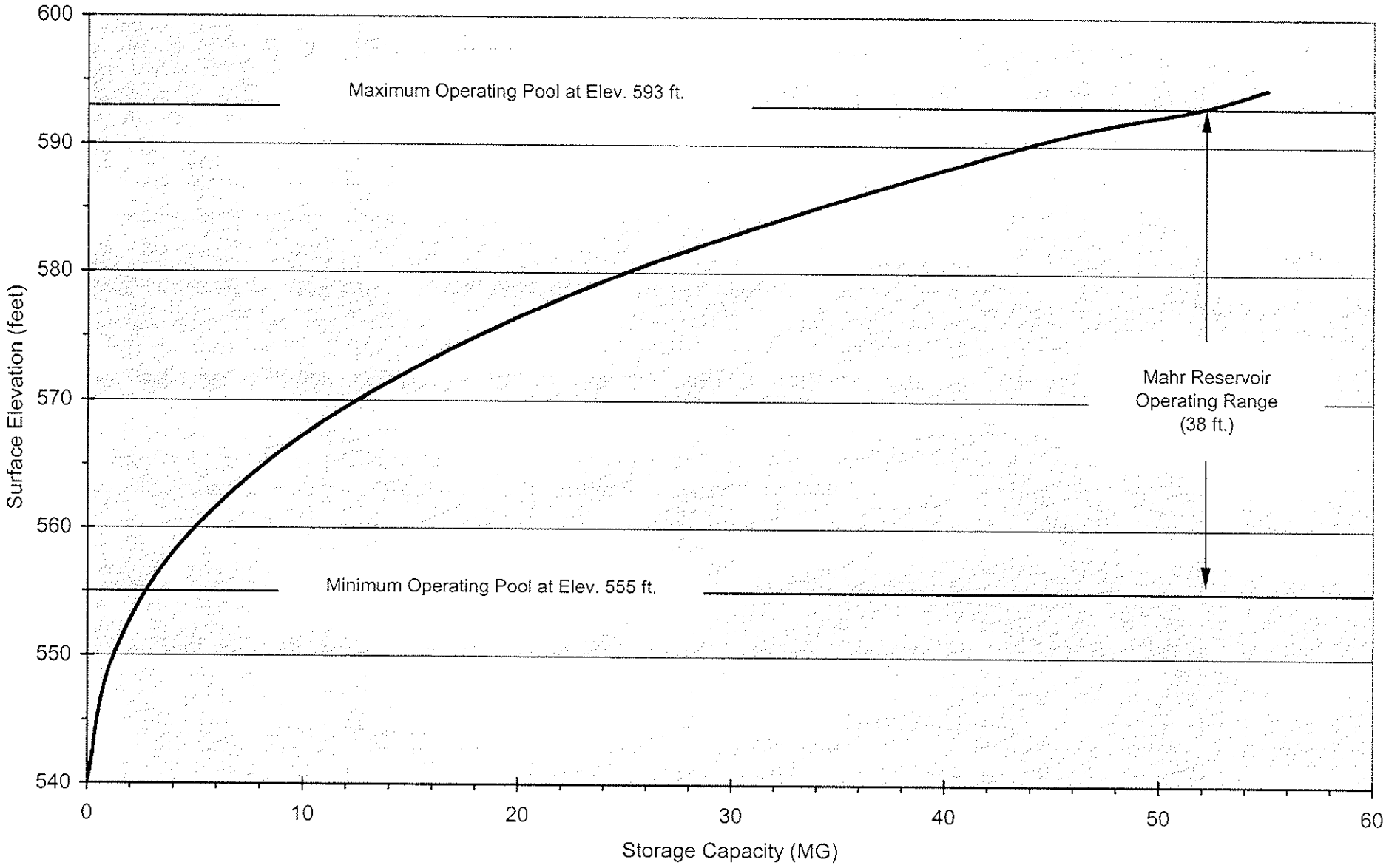
Mahr Reservoir

Integrating Mahr Reservoir into the Phase II recycled water system will provide operational storage for the 550 and 660 Zones, limited seasonal storage to meet peak summer demands, terminal storage to simplify pump station operations at the water reclamation plants, and emergency storage. Mahr Reservoir's operation will also allow the Encina WRF Pump Station to be controlled by the production rate at the plant, and not by the water level in the D Tanks. This will simplify controls for both the Encina and Gafner Pump Stations. Lastly, without Mahr Reservoir, a new storage tank would be required to provide operational storage for the 550 and 660 Zones, and the Meadowlark Pump Station would be controlled on the water levels at that tank.

Working storage capacity of Mahr Reservoir is estimated at 49 MG based on the capacity curve included in the reservoir construction drawings and reproduced in Figure 5-4. Based on the projected Phase II demands and assumed monthly demand variations as shown in Figures 5-1 and 5-2, system demands will exceed the reclamation plant supply for up to approximately three or four months during the summer. Excess recycled water stored at Mahr Reservoir during the winter months would be used to reduce the amount of supplemental potable water during the peak summer month(s).

As briefly discussed in Chapter 3, the District has experienced water quality problems with Mahr Reservoir. A more detailed discussion on water quality and recommended improvements to the Mahr Reservoir is presented in Appendix A.

FIGURE 5-4
MAHR RESERVOIR STORAGE CAPACITY CURVE



D Tanks

The two existing D Tanks, with a combined capacity of 2.5 MG, will provide operational storage for the 384 Zone. The flow of water between the 384 and 550 Zones (via a proposed pump station and pressure reducing station at the D Tank site) and addition of supplemental potable water to the system will be controlled based on D Tank levels.

Alternative Storage Options

The existing potable water reservoir referred as the C Tank, located east of El Camino Real and south of Tamarack Avenue, was initially proposed to provide additional operational storage for the 384 Zone. The District had indicated that the C Tank and existing supply pipeline could be converted from the potable system to the recycled water system. Results of initial hydraulic simulations indicated that the C Tank could not operate in conjunction with the D Tanks. This hydraulic incompatibility was due to a higher bottom elevation in the C Tank and the tank's remote location, relative to the D Tanks, from the Encina WRF. High head loss in the delivery mains during peak demands resulted in the C Tank completely draining while the D Tanks remained over half full. The C Tank could potentially be used as a forebay for the future Calavera Hills Pump Station.

A preliminary siting investigation was also conducted for a separate 550 Zone reservoir (1.5 to 3.0 MG) in the vicinity of Mahr Reservoir. A meeting was held between District staff and developers of La Costa Village to review potential sites. Due to significant open space and environmental constraints and planned developable areas, an above grade reservoir site at an elevation of 550 feet did not appear feasible.

5.6 DISTRIBUTION SYSTEM PUMP STATIONS

The following paragraphs briefly describe the two proposed Phase II distribution system pump stations. Later in this chapter preliminary design parameters, facility layouts and pump controls will be presented and discussed in more detail.

D Tank Pump Station

A pump station is proposed at the D Tank site to supply the upper zones from the Encina WRF. From about June through September, demands in the 550 and 660 Zones are projected to exceed capacity of the Meadowlark WPCF. Since Mahr Reservoir does not have the capacity to supplement supply in upper zones over this entire period, recycled water will need to be pumped up from Encina. Given the limited operational storage capacity in the 384 Zone, the D Tank pump station may

also operate for short periods during the day to prevent the D Tanks from overflowing.

It is proposed that the D Tank Pump Station operate based on water level settings on the D Tanks. The level settings would probably be adjusted seasonally, and summer settings may need to allow for the addition of potable water while pumping to the upper zones. It is anticipated that the pump station would not operate during the highest summer month demands, when storage from Mahr is required to supplement supply to the 384 Zone. It is important to note that the D Tank pump station would not operate in response to low pressures in the 550 Zone, since Mahr Reservoir outflows would make up any supply deficit.

550 (Calavera) Zone Pump Station

A 550 (Calavera) Zone Pump Station will be needed to serve the Calavera Hills development. The tentative location for the 550 (Calavera) Pump Station is along the future south extension of College Boulevard. Because this will pump to a closed pressure zone all demands must be met by the pump station. Based on projected demands and a peak hour factor of 6.0, the required Phase II capacity is estimated at approximately 1,050 gpm. However, the ultimate peak hour demand is approximately 1,500 gpm. To meet anticipated large demand variations, this pump station may require variable frequency drives or a hydropneumatic tank.

The 550 (Calavera) Zone Pump Station will boost water from the northern most area of the 384 Zone, approximately five miles from the source and storage in the 384 Zone. As a result, the suction side of this pump station will experience pressure swings of approximately 35 psi during a maximum day. In the ultimate system a proposed 16-inch pipeline from Encina WRF north to Cannon Road is proposed to help alleviate this pressure drop. This issue will need to be revisited in the pre-design study as the Phase II system builds out and more accurate demands and pressure data are available. It is also possible that the potable water system "C" Tank could be used as a forebay, although as earlier noted, this reservoir was unable to provide operational storage for the 384 Zone.

660 Zone Pump Station

The 660 Zone will be supplied from a proposed pump station located near the intersection of El Camino Real and Palomar Airport Road. In the Phase II distribution system, the 660 Zone will be a closed zone (without storage). In the Ultimate System, the zone will be expanded and include a storage tank. Based on projected Phase II demands and a peak hour factor of 6.0, the required capacity of the 660 Zone Pump Station is estimated at approximately 2,300 gpm.

5.7 ADDITIONAL MAJOR FACILITIES

Pressure Reducing Stations

Two pressure reducing stations supplying the 384 Zone from the 550 Zone are recommended for the Phase II distribution system. The primary pressure reducing station (PRS) would be constructed at the D Tank site and would open based on a low water level at the D Tank. This PRS facility would provide additional supply from Mahr Reservoir during the peak summer month(s) and also enable the entire distribution system to be supplied from Meadowlark during the lowest demand periods, thereby minimizing production and delivery costs.

A second PRS recommended near the intersection of Rancho Santa Fe Road and La Costa Avenue (OMWD service area) would operate during peak summer demand periods. This PRS would regulate downstream pressures for brief periods during peak irrigation demands in the summer and also supplement flow from Mahr Reservoir during the peak summer month(s).

A temporary pressure reducing station is also proposed to serve a portion of the 260 Zone from the 384 Zone in the Phase II System. This station would need to have the ability to supply very low flows during winter months and an approximate maximum flow of 225 gpm during peak summer months.

Supplemental Potable Water Feed

The existing potable water fill connection located at the D Tanks will be an important component of the Phase II recycled distribution system. At buildout of the Phase II system there will be a supply deficit for approximately three or four months of the year. Total volume of this deficit is estimated at approximately 120 to 300 MG. Mahr Reservoir has a working capacity of approximately 49 MG. Therefore, supplemental supply from the potable water system will be required. Potable water supply in the Phase II system will continue to be controlled based on water levels in the D Tanks as noted above.

The flow rate through the existing valve at the D Tanks currently can deliver approximately 2,000 gpm. A pressure sustaining feature on this valve may decrease the flow rate during peak demands on the potable water system. The District has indicated that improvements to the potable water system are planned that would increase the available flow rate. Therefore, a maximum flow of 3,000 gpm was modeled in the Phase II recycled water system.

5.8 DISTRIBUTION SYSTEM HYDRAULIC ANALYSIS

A Phase II model of the distribution system was developed with an average annual demand of 6,275 AFY to analyze and size distribution system facilities. The maximum day peaking curve developed for this analysis, extrapolated from existing system calibration data, has a peak hour factor of 6.0 and is shown in Figure 5-5. Tank level controls and pipeline diameters for future pipelines were adjusted in a series of iterative extended period simulations to comply with the design criteria summarized below. Diameters of existing recycled pipelines were not modified, since the pipelines are all relatively new, however, in several instances these pipelines had to be paralleled. Additionally, some proposed pipelines were upsized based on hydraulic analysis results for the Ultimate System.

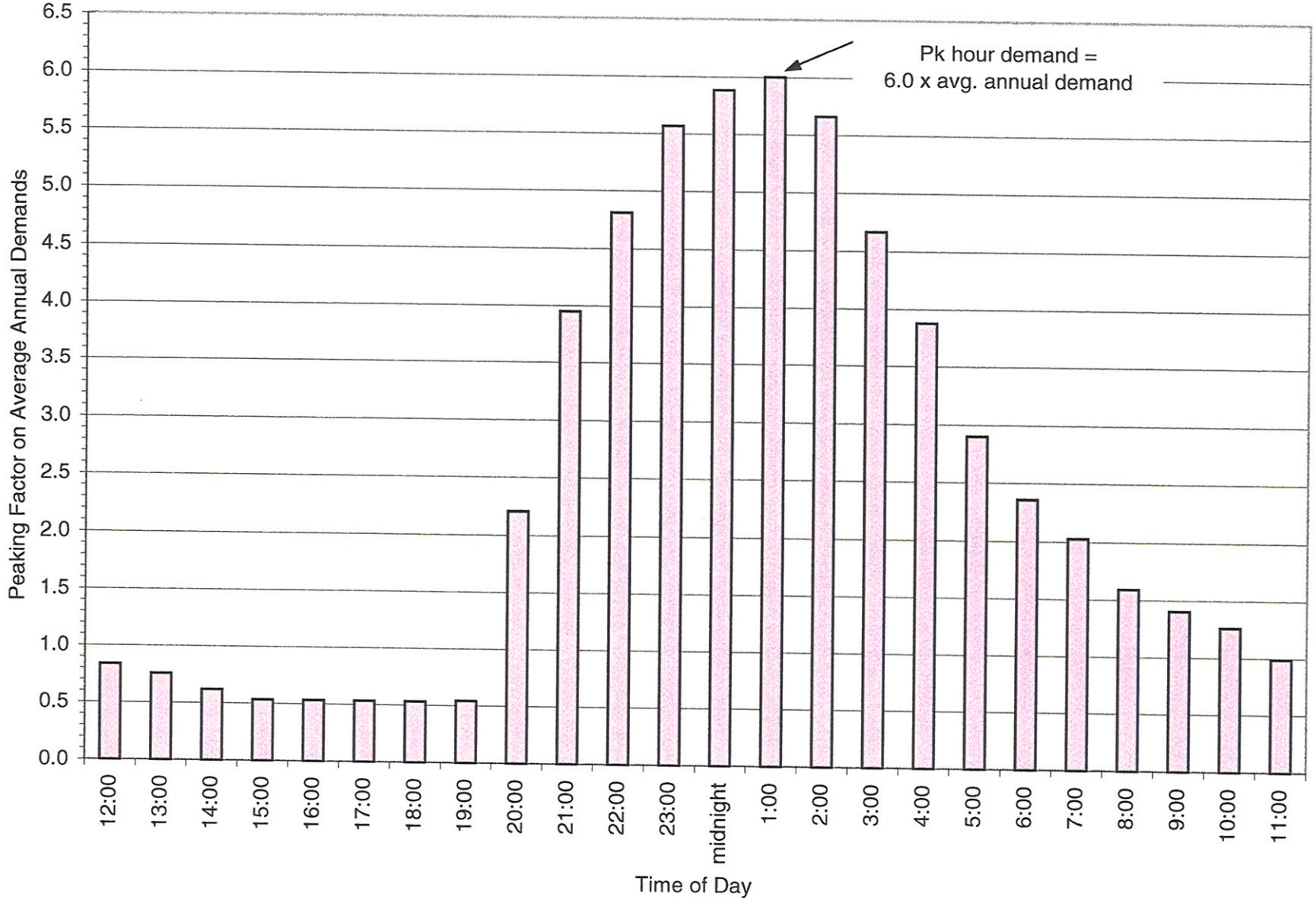
Design Criteria

Distribution system basic design criteria developed for the Phase II system is primarily based on the 1997 Master Plan Update and is summarized as follows:

- 120 psi maximum static pressure
- 55 psi minimum desired pressure
- Maximum pipeline velocity of 7 feet per second
- Demand peaking factors as shown in Table 5-1
- Reclamation plant capacities equal maximum month demand
- Pressure zone storage capacity equal to approximately two-thirds of the maximum day demand

In recycled water distribution systems, pressures zones are usually large, transmission mains are long, and looping is minimal when compared to potable water systems. These factors, combined with large demand peaks, can result in large pressure swings at the zone extremities. Pressure swings from static to peak hour were limited to 35 psi, where possible. The minimum desired pressure criteria of 55 psi is 15 psi higher than the 40 psi minimum potable water criteria to account for losses through the regulator and meter. Some existing potable water customers may experience lower pressures during peak irrigation periods when they switch to recycled water due to the recycled system hydraulics.

FIGURE 5-5
RECYCLED WATER SYSTEM MAXIMUM DEMAND DAY PEAKING CURVE
FOR PHASE II AND ULTIMATE SYSTEMS



The storage criteria established above was calculated based on the maximum day demand curve provided in Figure 5-5. Assuming a constant supply rate equal to the maximum day demand, an operational storage capacity of approximately one-third of the total maximum day demand is required to store excess supply during non-irrigation periods and to supplement supply where demands exceed the supply rate. An additional one-third of the maximum day demand was also assumed for contingency storage, which would account for dead storage in reservoirs and variations in supply flow rates. Based on these criteria, the 384 Zone should have 5.7 MG of available storage capacity (2.9 MG for "operational" storage), however, the capacity of the existing D Tanks is only 2.5 MG.

Model Development and Assumptions

Supply from the reclamation plants was modeled as a constant flow into the system equal to the maximum plant capacity. The D Tank Pump Station was not modeled in the maximum day simulation since under maximum day conditions the 384 Zone will be demanding flow from Mahr Reservoir to supplement demands. A maximum flow rate of 3,000 gpm was assumed at the D Tank potable water connection.

The starting water level of Mahr Reservoir was set at 580 feet above msl, which is approximately 50 percent full based on the capacity curve provided in Figure 5-4.

The distribution system analysis assumes that the District has negotiated an operational agreement with OMWD that allows for supply to be conveyed through the OMWD service area. Should this area be required to be metered resulting in only "one way" flow, Phase II system hydraulics may need to be re-evaluated.

Analysis Results

Analysis results from the extended period simulations indicate that supplying maximum day demands with a peak hour factor of 6.0 in the Phase II distribution system will be difficult operationally due to limited reclamation plant capacities and operational storage in the 384 Zone. Many of the pipeline diameters initially proposed in the 1997 Master Plan Update were upsized to satisfy design criteria.

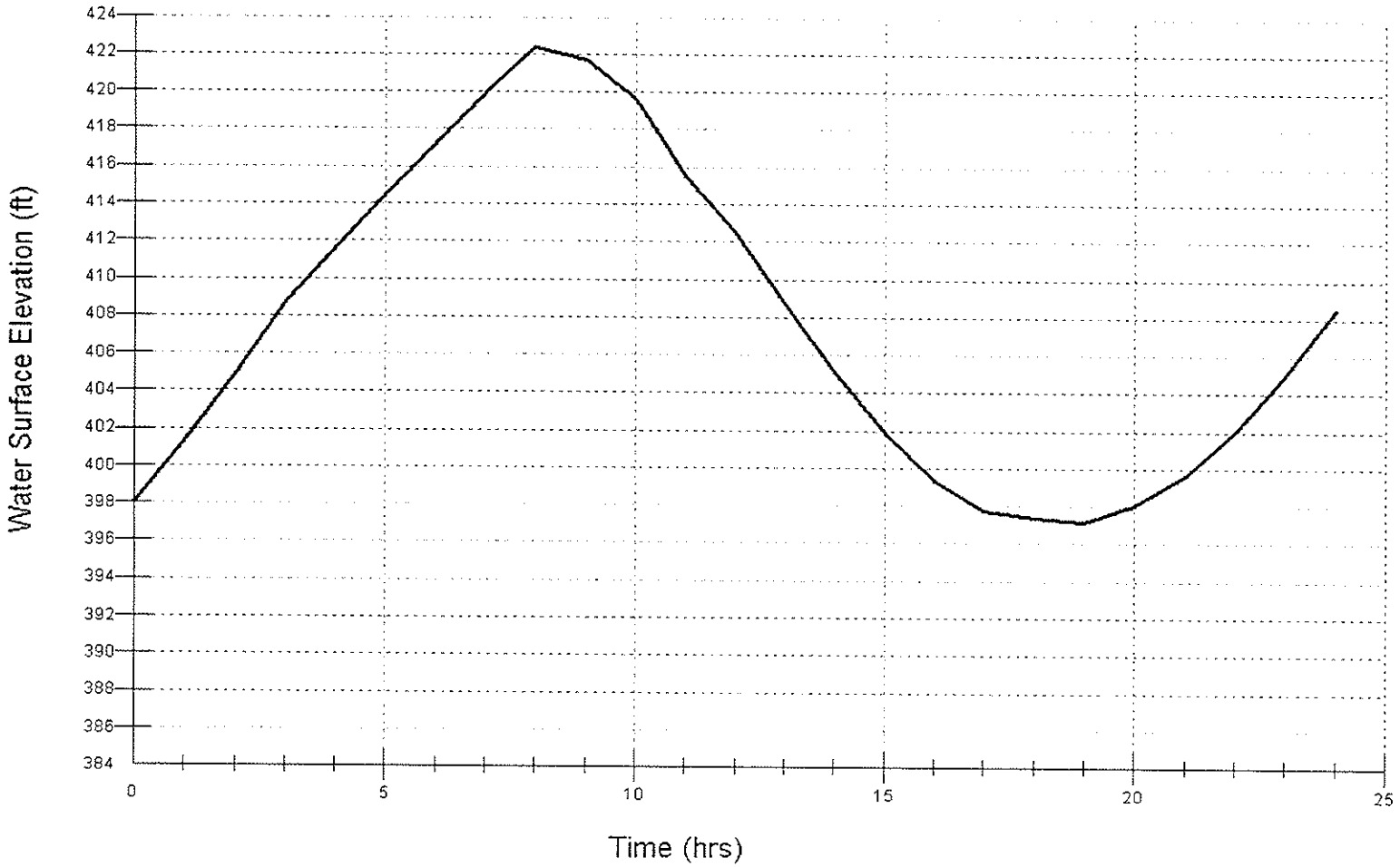
Initial analysis results showed large capacity deficiencies in the pipelines transporting water north from the transmission main connecting the Encina WRF with the D Tanks. A pipeline initially identified as a 6-inch diameter pipe was upsized to a 16-inch diameter main from Poinsettia to Palomar Airport Road. Even with this size increase the northernmost area of the 384 Zone experiences significant pressure swings that could be problematic for efficient irrigation system operations. A looped pipeline through the proposed Municipal Golf Course reduced this pressure swing to approximately 35 psi.

In the 384 Zone, flow must be supplemented from the potable water system. Over the course of the 24-hour simulation, potable water flow rates varied from 1,000 gpm to 3,000 gpm to compensate for the lack of sufficient operational storage capacity at the D Tanks. A critical assumption is that the potable system will be capable of supplying those flow rates when necessary. A high flow rate from Mahr Reservoir into the 384 Zone (up to 4,000 gpm) was also required to supply peak hour demands without draining the D Tanks. By adjusting tank control levels, the D Tanks were kept just within the high and low tank levels, as shown in Figure 5-6. Utilizing the proposed clearwell for operational storage by decreasing the pumping rate during non-irrigation periods and pumping at a rate greater than the Encina WRP maximum capacity during peak demands would simplify 384 Zone Operations. Under this scenario, constant potable water supply rate of 2,000 gpm would be sufficient.

With maximum day demands in the model, Mahr Reservoir drained at a maximum flow rate of approximately 9,000 gpm. Initial analysis results indicated a large pressure drop in the 550 Zone between the Meadowlark WPCF and El Camino Real. Instead of upsizing the proposed 24-inch transmission main (Alga Road), the pressure drop was reduced by including the second PRS along Rancho Santa Fe Road which provided an alternate feed from the 550 Zone to the 384 Zone. Despite this improvement, the northern extremities of the 550 Zone still experienced a large pressure swing, however, minimum desired pressures were satisfied. One possible method to reduce this pressure swing at peak hour is to schedule irrigation periods of larger users within the system.

During the maximum day simulation suction pressures at the proposed 660 Zone Pump Station varied by 40 psi. Within the 660 Zone distribution system, very high head loss and resulting pressure swings occurred at peak demand in the existing 8-inch pipeline in Melrose Drive. The District may want to investigate additional parallel pipelines in future developments within Rancho Carrillo. An alternative pump station location was analyzed at the intersection of Melrose and Alga Road. This location would have a suction pressure variation of approximately 20 psi, however, the discharge head would need to be greatly increased to overcome the very high head loss in the 8-inch pipeline in Melrose. In addition, existing pipelines may not have the proper pressure class.

FIGURE 5-6
D TANK WATER LEVELS DURING PHASE II MAXIMUM DEMAND SIMULATION



5.9 RECOMMENDED SYSTEM AND CAPITAL COST OPINION

The recommended Phase II recycled water system is illustrated in Exhibit D-3 (Appendix D). Proposed Phase II pipeline diameters are indicated on the map and the pipelines are color coded according to pressure zone. The pipeline sizes listed in this exhibit also satisfy the design criteria in the expanded Ultimate System. Figure 5-7 within this section illustrates the recommended control scheme for the Phase II system.

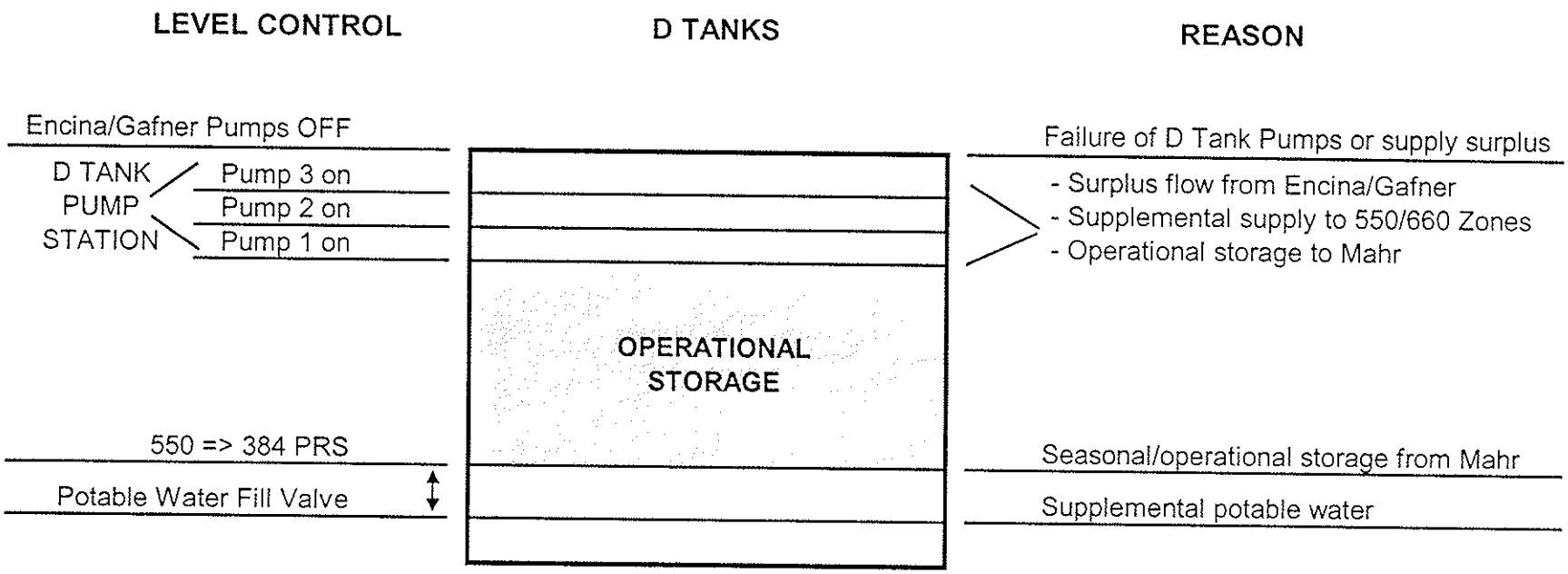
Pump Station Preliminary Design

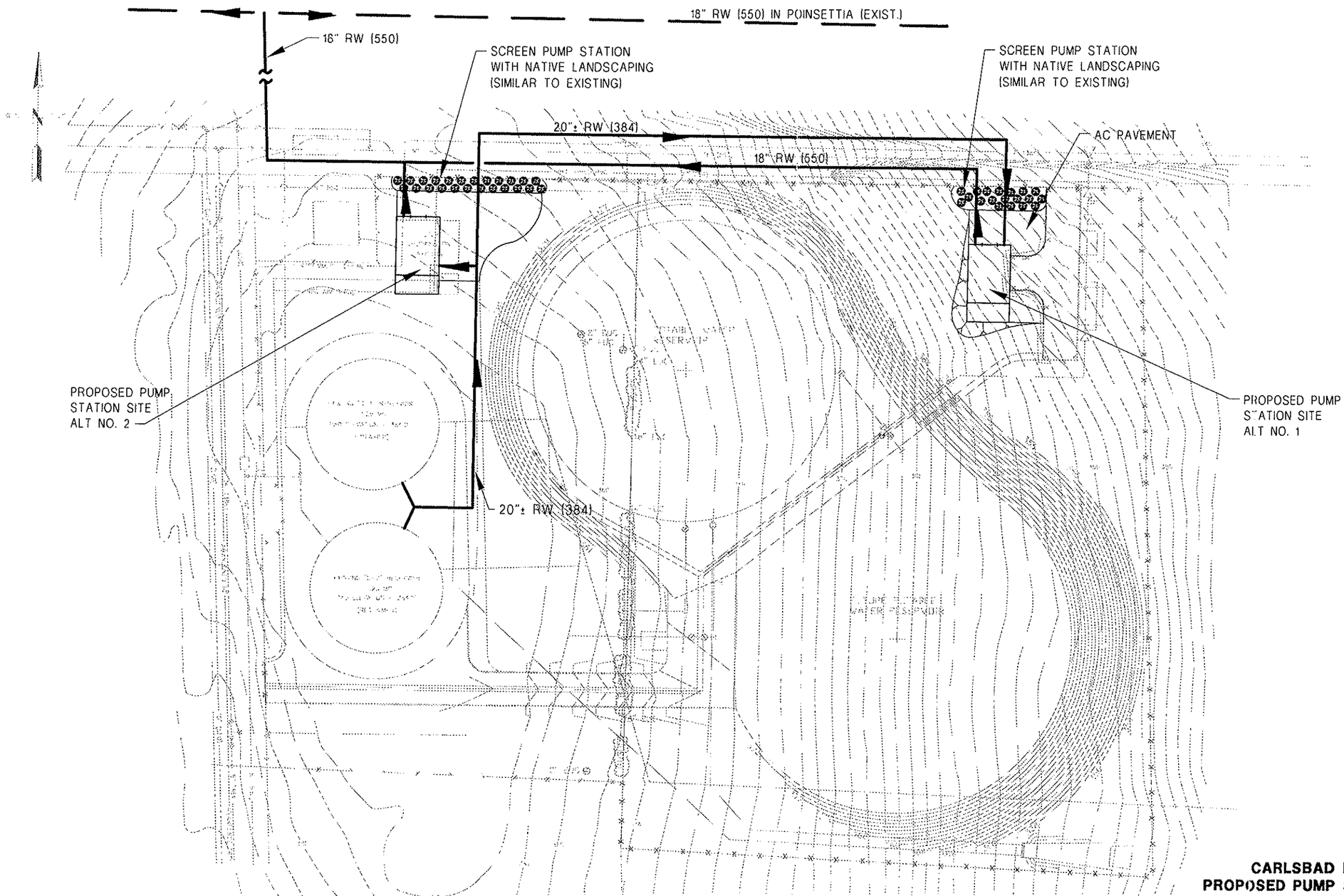
Table 5-4 summarizes the recommended Phase II pump station capacities. Figures 5-8 and 5-9 present site plans for the distribution system pump stations.

TABLE 5-4
PUMP STATION PRELIMINARY DESIGN PARAMETERS

Phase II Pump Station	Maximum Capacity	Design TDH	Number of Pumps
Encina WRF Clearwell => 384 Zone	4,500 gpm	340-380 ft.	4
Gafner WWTP Clearwell => 384 Zone	699 gpm	330-370 ft.	3
D Pump Station 384 Zone => 550 Zone	3,000 gpm	130-200 ft.	4
660 Zone 550 Zone => 660 Zone	2,300 gpm	70 - 190 ft.	4

FIGURE 5-7
PROPOSED PHASE II SYSTEM CONTROL SCHEMATIC AT THE D TANKS





CARLSBAD MUNICIPAL WATER DISTRICT
PROPOSED PUMP STATION AT TWIN 'D' RESERVOIRS
- ALTERNATE SITE PLAN LOCATIONS

FIGURE 5-8

P:\082\080\82080FIG5-8.DWG May 22, 2000

For the Phase II system, a maximum capacity of approximately 3,000 gpm is recommended for the D Tank Pump Station. This capacity would be sufficient to supply the upper zones at buildout in the event that the Meadowlark WPCF is out-of-service, and would enable the Encina WRF Pump Station to operate at a constant flow rate, regardless of demands in the 384 Zone. Four pumping units (three duty pumps and one stand-by pump) are recommended. It should be noted that a pump station with a capacity of 3,000 gpm could supply a closed system with average annual demands up to approximately 800 AFY. Prior to completion of the transmission main to Mahr Reservoir the D Tank Pump Station could possibly be utilized to supply a portion of the 550 Zone operated as a closed zone.

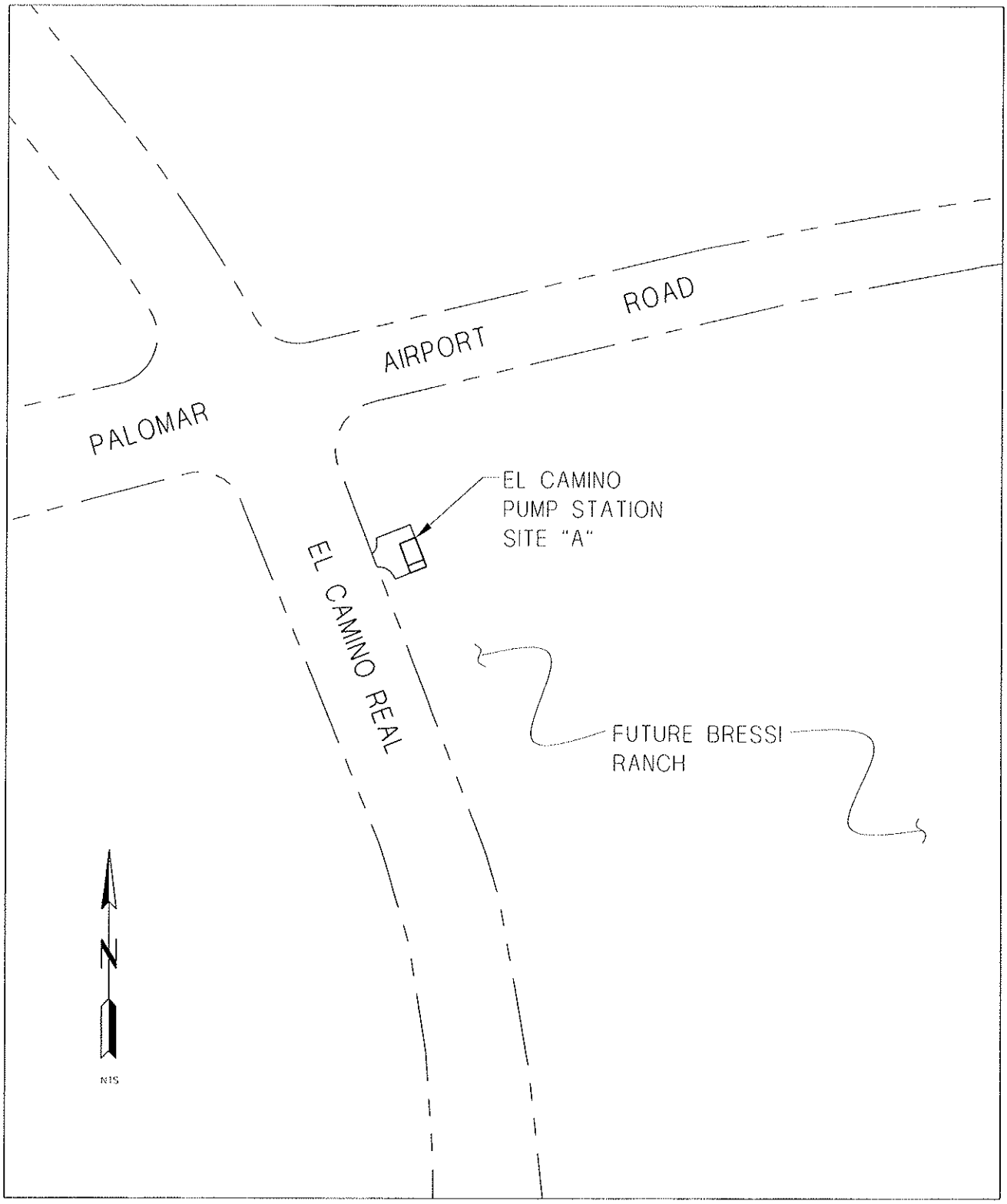
A preliminary site plan for the D Tank Pump Station alternative is provided in Figure 5-8. As part of the initial preliminary design for the pump station and to assist the District with their CEQA compliance for the project, three locations were initially considered for the pump station. One location, between existing South D Tank and the existing potable water reservoir, was eliminated from consideration due to the proximity to existing potable water pipelines and this location has potential as a future reservoir location. The remaining locations shown as alternative Nos. 1 and 2 are currently included in the District's CEQA documentation. The final location will be determined during the final engineering design phase.

Pump controls for the Gafner Pump Station are expected to be fairly simple since any surplus supply in the 384 Zone would be pumped up to Mahr Reservoir. It is envisioned that extensive telemetry features allowing coordination with pumps at Encina will not be required. However, if Gafner is connected to the distribution system prior to Mahr Reservoir or the Encina WRF, a control system may need to be developed to operate in conjunction with the existing El Camino Pump Station.

The proposed 660 Pump Station site is shown in Figure 5-9, which will operate in a closed system. A hydropneumatic tank or variable speed pumps with recirculation should be considered during the final design. To assist the District in CEQA compliance for the project, two locations were initially considered for the 660 Zone Pump Station. One location, along El Camino Real (near the District's headquarters), was eliminated from consideration due to the potential proximity to habitat. The location depicted in Figure 5-9 shows the site currently depicted in the District's environmental documentation. This location is expected to be compatible with the current land planning efforts for the future Bressi Ranch development.

System Controls

To simplify operation of the reclamation plant pump stations it is recommended that the flow of water between the 384 and 550 Zones (via a proposed pump station and pressure reducing station at the D Tank site) and addition of supplemental potable water to the system be controlled based on D Tank levels.



660 BOOSTER PUMP STATION
PROPOSED SITE

FIGURE 5-9

The proposed D Tank level controls are illustrated schematically in Figure 5-7. If supply from Encina/Gafner exceeds demands within the 384 Zone, a pump station at the D Tanks will operate and discharge excess supply to the 550 Zone and/or to Mahr Reservoir. Likewise, if flow from Encina/Gafner is insufficient to meet 384 Zone demands, the supplemental potable water feed valve would open or a pressure reducing station would open to supply the lower zone from Mahr Reservoir.

It is anticipated that the D Tank level controls would be changed seasonally or monthly depending on how the system is to be operated. For instance, there might be low demand periods during winter months when supply from Encina and Gafner is not needed. All the supply would therefore come from the Meadowlark WPCF through the pressure reducing station, which would be controlled to fill the D Tank. During peak demand periods system operators would decide whether to make up the flow deficit in the 384 Zone from the potable water system or by draining Mahr Reservoir.

As discussed previously, the 384 Zone is deficient in storage, which complicates operations at the D Tank. To help reduce this deficiency it is recommended that the District construct a clearwell at the Encina WRF. For the Phase II system the District should target approximately 2 MG for clearwell storage to provide operational flexibility. With this available storage the Encina Pump Station could be operated to pump at a higher discharge rate during the peak irrigation period, and pump less during off-peak periods. The District may also be able to shut down the pump station during the peak time-of-use energy period, which corresponds with minimum demands on the recycled water system.

Pipeline Alignments

As part of the initial planning for the Phase II distribution system, the District was provided a preliminary layout of a potential Phase II system that was used by the District for its CEQA process. In developing the Phase II system, careful attention was given to locating new recycled pipelines in existing or future roadways to minimize environmental impacts. A number of areas of the City of Carlsbad have been designated as permanent open space, mitigation land, or habitat management, which makes it difficult to locate future recycled water pipelines in the undisturbed areas, unfortunately, eliminating potentially shorter more cost effective pipelines. Several critical pipelines alignments were evaluated and are discussed below.

In order to place Mahr Reservoir into service and establish the 550 Zone, a transmission main must be completed between El Camino Real and the reservoir, with the primary route within Alga Road. A couple of alignments were investigated to the reservoir that involved use of SDGE easements, but were determined to be constrained due to proposed dedicated habitat management land as part of the Villages of La Costa development. The preferred alignment became Alga Road and

Rancho Santa Fe Road. The recycled pipeline between Meadowlark and Mahr Reservoir is under design as part of the Rancho Santa Fe Road re-alignment improvement project. The pipeline was increased from 18-inch to 24-inch as part of the Phase II hydraulic analyses. Its construction is dependent on the road improvement project, which currently has been delayed due to environmental issues. Should this project continue to delay it could impact the District's ability to bring Mahr reservoir on-line.

Another critical pipeline is the transmission main from Encina to the D Tank site to provide increased recycled water supply to the Phase II system. This pipeline requires crossing the Interstate 5 freeway. Several different crossings were considered, however, the preferred alignment appears to be a jacked pipeline from south of the Encina WRF, east to Camino de las Ondas. The remaining transmission main to the D Tank site would head south and follow Poinsettia Lane.

Capital Cost Opinion

Table 5-5 summarizes the preliminary opinion of probable construction cost for the Phase II distribution system, including transmission and distribution pipelines, the two distribution system pump stations, and phased Mahr Reservoir improvements. Total project contingencies were assumed at 20 percent of the Phase II costs. Contract overhead and profit was assumed at 20 percent and engineering/administration at 15 percent. The opinion of cost does not include the Encina 384 Pump Station and 2 MG Forebay, which are assumed part of the Encina facility costs. In addition, no costs have been included for the acquisition or operational agreement for Mahr Reservoir with Vallecitos Water District.

The total Phase II system costs, not including soft costs, is approximately $12.1 million. Based on discussions with the District, approximately $10 million was budgeted for the Phase II system. Some of the cost increases are associated with larger transmission main size than compared to the 1997 Master Plan Update. This was a direct result of the detailed hydraulic analyses performed on the distribution system design criteria. It appeared that only preliminary hydraulic calculations were performed in the 1997 Master Plan Update.

A major Phase II facility cost is the Mahr Reservoir improvements. A two-phased approach is recommended for Mahr Reservoir, with the first phase including dredging and cleaning, aeration/destratification system, inlet/outlet works, and minor site improvements. Should recycled water quality improve in the distribution system, the second phase improvement, AC concrete liner and polypropylene cover, could possibly be deferred. This would reduce the Phase II cost by approximately $1.4 million. Careful monitoring of water quality in Mahr Reservoir is critical to assess the success of the first phase of improvements.

TABLE 5-5
CARLSBAD MUNICIPAL WATER DISTRICT
PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST
RECLAIMED WATER SYSTEM PHASE II EXPANSION

Item	Unit Cost	Unit Value	Total
Pump Station at Twin "D" Reservoir Site			
Total Phase II Pump Station Cost	lump sum	1 (typical)	$800,000
Itemized Costs (included in total cost above)			
Individual Pump Cost			$50,000
Hydropneumatic System			$50,000
660 Boosted Pump Station			
Total Phase II Pump Station Cost			$425,000
Itemized Costs (included in total cost above)			
Individual Pump Cost			$35,000
Hydropneumatic System			$35,000
Reclaimed Water Piping			
260 Zone			
12" Diameter	$61 / linear ft	2,542 ft	$156,000
Subtotal Piping Cost for 260 Zone			$156,000
384 Zone			
8" Diameter	$46 / linear ft	323 ft	$15,000
12" Diameter	$61 / linear ft	3,752 ft	$230,000
16" Diameter	$71 / linear ft	6,061 ft	$433,000
24" Diameter	$114 / linear ft	10,970 ft	$1,255,000
Subtotal Piping Cost for 384 Zone			$1,933,000
550 Zone (Calavera)			
4" Diameter	$35 / linear ft	5,737 ft	$199,000
8" Diameter	$46 / linear ft	1,212 ft	$56,000
12" Diameter	$61 / linear ft	100% developer	$0
Calaveras Booster Pump Station	lump sum	50% developer	$300,000
Subtotal Piping Cost for 550 Zone (Calavera)			$555,000
550 Zone			
4" Diameter	$35 / linear ft	3,181 ft	$110,000
8" Diameter	$46 / linear ft	11,017 ft	$506,000
10" Diameter	$55 / linear ft	3,130 ft	$173,000
12" Diameter	$61 / linear ft	4,233 ft	$259,000
16" Diameter	$71 / linear ft	3,237 ft	$231,000
18" Diameter	$83 / linear ft	13,126 ft	$1,086,000
20" Diameter	$94 / linear ft	6,043 ft	$568,000
24" Diameter	$114 / linear ft	24,919 ft	$2,850,000
Subtotal Piping Cost for 550 Zone			$5,783,000
260 Zone Temporary Pressure Reducing Station	lump sum	1 (typical)	$75,000
Service Lines and Retrofits	lump sum		$200,000
Total Phase II Piping Cost			$8,702,000

TABLE 5-5 (continued)
CARLSBAD MUNICIPAL WATER DISTRICT
PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST
RECLAIMED WATER SYSTEM PHASE II EXPANSION

Item	Unit Cost	Unit Value	Total
Mahr Reservoir Improvements			
Initial Phase II Improvements (From Table 5-1 in Appendix A)			$780,000
Deferred Phase II Improvements (From Table 5-1 in Appendix A)			$1,423,000
SUBTOTAL OF ALL INITIAL PHASE II COSTS			**$12,130,000**
Contingency (20%)			$2,430,000
Contractor Overhead & Profit (20%)			$2,910,000
Engineering & Administration (15%)			$2,620,000
OPINION OF INITIAL PHASE II PROBABLE CONSTRUCTION COSTS			**$20,090,000**

Notes:
1. Pump station costs based on cost curves from Pumping Station Design by Sanks with ENRCCI = 6127 for December 1999.
2. Unit costs for piping are based on City of San Diego Clean Water Program with ENRCCI = 6127 for December 1999.
3. Costs for land acquisition are not included.
4. Initial improvements for Mahr Reservoir include: dredging and cleaning reservoir bottom, aeration/destratification system, modifying the inlet/outlet works, and minor site work. Deferred improvements include installation of porous AC concrete liner, polypropylene cover, and associated appurtenances.

Chapter 6
Ultimate Distribution System

Upon build-out of the Phase II system and corresponding capacity short falls at the reclamation plants, it is anticipated that the District will proceed with construction of the Ultimate System. The Ultimate System has been planned based on a second phase expansion of the Encina WRF and a small expansion of Meadowlark to increase recycled water supply.

6.1 RECYCLED WATER DEMANDS AND PEAKING FACTORS

The total Ultimate System reclamation plant capacity is projected to be approximately 20 MGD. Per the District's design criteria, this capacity will be equivalent to the recycled system's average demand during the maximum month. Utilizing a peak month factor of 2.2, the target average annual recycled demand for the Ultimate System is approximately 10,000 AFY.

The peaking factors and projected ultimate demands are provided in Table 6-1.

TABLE 6-1
ULTIMATE AVERAGE AND PEAK RECYCLED WATER DEMANDS

Demand Condition	Peaking Factor	Ultimate Demand	
		(AFY)	(gpm)
Average Annual	1.0	9,938	6,162
Max Month	2.2	21,864	13,555
Max. Day	2.5	24,845	15,404
Peak Hour	6.0	59,628	36,969
Min. Month	0.15	1,491	924

The basic strategy for reaching Ultimate System recycled water use is to seek infill recycled water markets that allow for incremental demand increase at a relatively low capital cost. Since the Phase II system will consist of backbone transmission facilities along El Camino Real, Alga Road, Palomar Airport Road, and other key roadways, the District will have major infrastructure in place to serve nearly all new development projects proposed for the City of Carlsbad. By continuing to require developers to dual pipe subdivisions, increased recycled demands should be realized while minimizing capital improvement projects.

The Ultimate System, therefore, targets these infill areas rather than areas remote from the backbone Phase II system. For example, the older City of Carlsbad area (Carlsbad Village Drive) is not planned for recycled water service under the Ultimate System. This area would require extensive new transmission facilities and potential costly retrofits to convert to recycled water, and was therefore excluded. Infill areas such as business parks north and south of Palomar Airport Road are included in the Ultimate System. Although these areas may require retrofitting, no extensive transmission and pumping system is necessary.

Several future master planned developments within the City should offer the District great potential for increasing the recycled demands, including Bressi Ranch and La Costa Villages. It is recommended that the District conduct individual recycled water master plans for these larger projects to properly size the onsite distribution system and determine the appropriate pressure zones and optimum connection points to the backbone system.

Table 4-3 summarized potential Ultimate System demand, which includes another 1,000 AFY of demand currently served from potable irrigation meters and 300 AFY of potential demand within OMWD service area. These demands were added to the Phase II hydraulic model and hydraulic analyses were performed as described in Section 6.6.

6.2 RECLAMATION PLANT SUPPLY

The Ultimate System will receive recycled water from Meadowlark, Encina, and Gafner plants. To supply this increased recycled water demand, future plant expansions are assumed at both Encina and Meadowlark. The future capacity of each plant is shown in Table 6-2.

TABLE 6-2
ULTIMATE RECYCLED WATER SUPPLY

Water Reclamation Plant	Phase II Capacity		
	MGD	AFY	gpm
Encina	16.0	17,917	11,111
Gafner	1.0	1,120	694
Meadowlark	3.0	3,359	2,083
Total	**20.0**	**22,396**	**13,889**

Additional supply sources, such as Mahr Reservoir, Lake Calavera, or supplemental potable water, will still be needed to supply system peak demand requirements. This assumes new plant capacity will also be based on maximum month demands, which are lower than the maximum day peaking factor.

6.3 DISTRIBUTION SYSTEM PRESSURE ZONE

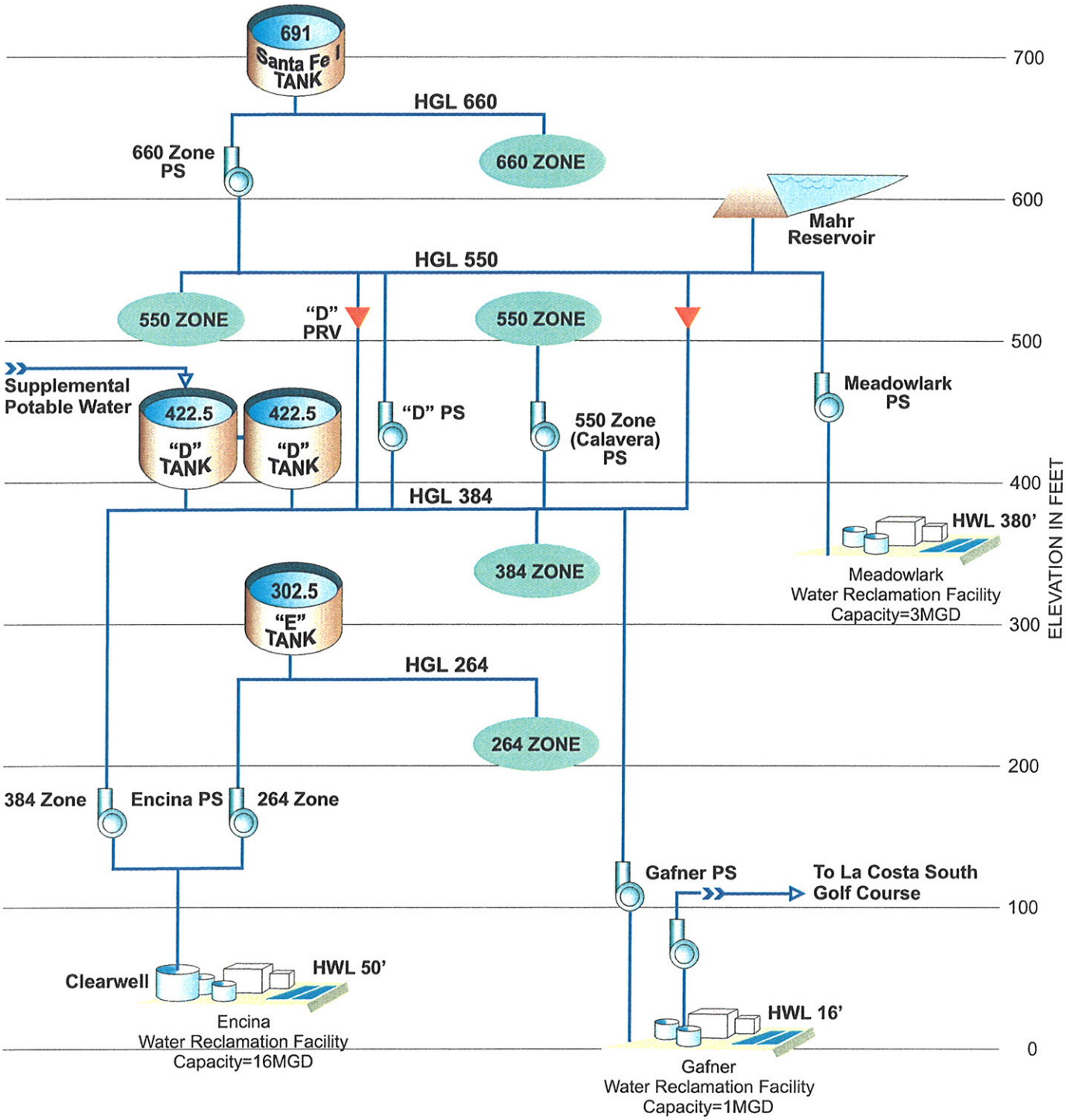
The Ultimate System will consist of five pressure zones, referred to as the 260, 384, 550 (Calavera), 550, and 660 Zones. Table 6-3 lists the projected ultimate demands within each pressure zone. An Ultimate System distribution system schematic is illustrated in Figure 6-1.

The 260 Zone will ultimately be supplied by separate pumping units at Encina. The District's existing 1.5 MG "E" Tank will be converted from potable to recycled service to provide operational storage for this 260 Zone.

TABLE 6-3
ULTIMATE DEMANDS BY PRESSURE ZONE

Pressure Zone	Avg Annual Demand (AFY)	Avg Annual Demand (gpm)	Max Day (gpm)	Peak Hour (gpm)
260	553	343	857	2,057
384	4,977	3,085	7,714	18,513
550 (Calavera)	402	249	623	1,496
550	2,345	1,454	3,634	8,723
660	1,213	752	1,880	4,512
Total	**9,490**	**5,883**	**14,708**	**35,300**

Note: Demands do not include the La Costa South Golf Course, which is supplied directly from the Gafner WRP



LEGEND

691 — RESERVOIR, H.W.L.

PUMP STATION

PRESSURE REDUCING STATION

NOTE: HGL'S AND PRESSURE ZONES ARE BASED ON LOW WATER LEVELS OF TANKS.

ULTIMATE SYSTEM SCHEMATIC

FIGURE 6-1

6.4 RECYCLED WATER STORAGE FACILITIES

The Ultimate System storage requirements were evaluated based on providing approximately two-thirds of the maximum day demand. Table 6-4 summarizes the projected storage needs for the Ultimate System. With the existing storage facilities that the District is making available to the recycled water system, only the 384 Zone would be deficient in storage.

TABLE 6-4
REQUIRED STORAGE CAPACITY BY ZONE

Pressure Zone	Average Annual Demand		Required Storage (2/3 Max Day) (MG)	Available Storage Facilities	SURPLUS/ (DEFICIT) (MG)
	(gpm)	(MGD)			
260	343	0.49	0.82	E Tank - 1.5 MG	0.7
384 550 (Calavera)	3,335	4.80	8.00	D Tanks - 2.5 MG Encina Forebay* - 2.0 MG	(3.5)
550	1,454	2.09	3.49	Mahr Reservoir - 49 MG	45.5
660	752	1.08	1.80	Santa Fe I Tank - 2.5 MG	0.7
Totals	**5,883 gpm**	**8.5 MGD**	**14.1 MGD**	**57.5 MG**	**43.4**

* Proposed Phase II Facility

Encina Clearwell / Forebay Expansion

Extremely high land costs make new 384 Zone storage too expensive to pursue. Therefore, additional forebay storage at Encina could be utilized to supply daily peak demands in the 384 Zone. This can be accomplished with forebay storage to allow a higher flow rate to be pumped during the peak irrigation period while keeping production rates constant.

The Phase II system recommended forebay storage at Encina to provide operational flexibility. A capacity of 2.0 MG was recommended, which would allow the pump station to operate slightly above or below the constant plant output and may also offer the District opportunities for off-peak pumping. Additional forebay storage will be required to meet Ultimate System peak hour demands for the 384 and 540 Zones. It is recommended that approximately one-half of the Encina WRF capacity be planned for the Ultimate System, which results in an 8.0 MG forebay reservoir.

E Tank

The existing potable water "E" Tank is located near Hidden Valley Road and Stewart Road east of Legoland. The 1.5 MG tank can be converted to a recycled water tank and used to serve an expanded 260 Zone.

Santa Fe I Tank

The Santa Fe I Tank is an abandoned 2.5 MG potable water tank located in the City of San Marcos south of Palomar Airport Road and east of the City of Carlsbad's city limits. The 660 Zone is a closed zone in Phase II and will become an open system with the connection to the Santa Fe I Tank. It is assumed the 660 Booster Pump Station will then be operated based on tank water levels.

Lake Calavera

Lake Calavera is located in the northeast corner of the City and was constructed in 1940 as a water storage reservoir. The facility has been abandoned since Colorado River was first imported in 1957. The reservoir has a capacity of 520 acre-feet with a spillway elevation of 216.5 feet.

Lake Calavera primarily was investigated as a possible recycled water storage facility in the Ultimate System. In the Ultimate System, seasonal storage will be needed to make up the difference between maximum day demands (22.2 MGD) and the production rate of the reclamation plants, which is equivalent to the maximum month demand (20 MGD). The required seasonal storage volume is conservatively estimated at approximately 30 MG (2.2 MGD flow deficit for a maximum of 15 days), which could be provided by Mahr Reservoir. Additional seasonal storage will therefore not be required in the Ultimate System.

Lake Calavera was also considered for additional operational storage in the Ultimate System for the 384/550 (Calavera) Zones. This would require a new pump station with a hydraulic lift of approximately 150-200 feet and new transmission mains. Since a larger forebay at the Encina WRP could serve this same purpose with lower construction and operating costs, Lake Calavera was not integrated into the Ultimate System.

The proposed Phase II system would benefit from increased storage because of the reclamation plant shortfall. Initially, Lake Calavera was discounted in the Phase II system since no facilities were proposed near the lake. With the proposed Calavera Hills development's interest in recycled water, it appears that Phase II facilities could be extended near the lake. Use of Lake Calavera in Phase II could potentially eliminate the need for potable make-up water. The District should continue to review the feasibility and opportunities for use of Lake Calavera for recycled water storage.

6.5 Pump Stations

Encina Pump Station (260 and 384 Zones)

Ultimately, the Encina Pump Station will consist of separate pumping units to supply the 260 and 384 Zones. For most of the year, a portion of the supply pumped to the 384 Zone will need to be pumped again at the D Tank Pump Station to supplement supply to the upper zones.

Based on projected zone demands and a maximum day peaking factor of 2.5, the required 260 Zone pumping capacity is estimated at approximately 1,000 gpm. It is recommended that two duty pumping units be planned for the Encina 260 Pump Station, since the Ultimate System could have the ability to feed the 260 Zone from the 384 Zone with the addition of a pressure reducing station between zones. There are several locations between the pump station and E Tank, where this could be accomplished.

The 384 Zone portion of the Encina Pump Station would normally be designed to supply a relatively constant flow from the reclamation plant. Since the Encina Forebay will be used to offset the 384/550 (Calavera) Zone storage deficit in the Ultimate System, the pump station must supply approximately 13,000 gpm during peak summer irrigation periods.

660 Zone Pump Station

The 660 Zone pump station will need to be modified to water level control when the Santa Fe I tank is phased into service for the Ultimate System. Based on projected Ultimate System demands and a maximum day peaking factor of 2.5, the required capacity is estimated at approximately 1,900 gpm. This is actually 400 gpm less than the pump station requirement in its Phase II closed system operation.

6.6 HYDRAULIC ANALYSIS AND RECOMMENDED SYSTEM

Assumptions

Extended period simulations with maximum day demands were performed on the Ultimate System model. No supplemental potable water was used in the analysis, thus depending on Mahr Reservoir for seasonal storage. Gafner was modeled to produce a constant supply of 0.5 MG into the 384 Zone as in the Phase II system. The remainder of the water produced at Gafner was again assumed to directly supply the La Costa South Golf Course. Meadowlark produced a constant supply of 3 MG into the 550 Zone, which may require capacity upgrades to its existing pump station. Encina was assumed to produce a constant supply of 16 MG.

The Encina 260 Pump Station was controlled by the level of the "E" Tank. The Encina 384 Pump Station operated at two pumping rates during a maximum day demand. A flow exceeding the Encina plant production was pumped for nine hours from the forebay. The "D" Pump Station was modeled pumping a constant supply into the 550 Zone. The 660 Zone Pump Station was modeled with level control off the Santa Fe I Tank.

Maximum Day Analysis Results

The Ultimate System maximum day simulation was performed for a 24-hour period. Tabular data for the peak hour results are shown in Appendix C-3. Figures 6-2 through 6-5 illustrate reservoir fluctuations during the maximum day demand. The "D" Tank reservoirs (Figure 6-2) showed nearly full utilization of the entire tank volume. The Phase II controls were modified to allow complete use of the "D" Tanks for operational storage. The Encina Forebay is utilized for additional operational storage.

Under maximum day demand conditions, Mahr Reservoir will drain with all the plants at full production (Figure 6-3). The Santa Fe Tank showed ideal operations under the maximum day simulation (Figure 6-4). The "E" Tank, although not showing full recovery (Figure 6-5), could easily be replenished with modified pump controls.

Recommended Transmission Mains

The recommended Ultimate System is illustrated in Exhibit D-4. Pipelines are colored by zone and diameters are labeled.

The higher peak flows in the Ultimate System resulted in the need to parallel key sections of the Phase II backbone system to minimize system headlosses. These areas include:

- A new 12-inch pipeline between Alga Road and Rancho Santa Fe Road, east of La Costa South Golf Course.

- A second discharge pipeline from the Encina 384 Pump Station, northward to Cannon Road and crossing Interstate 5 is necessary to reduce pipeline velocities and minimize pressure swings in the 384 Zone and the suction side of the 550 (Calavera) Pump Station.

FIGURE 6-2
D TANK WATER LEVELS DURING ULTIMATE MAXIMUM DAY DEMAND SIMULATION

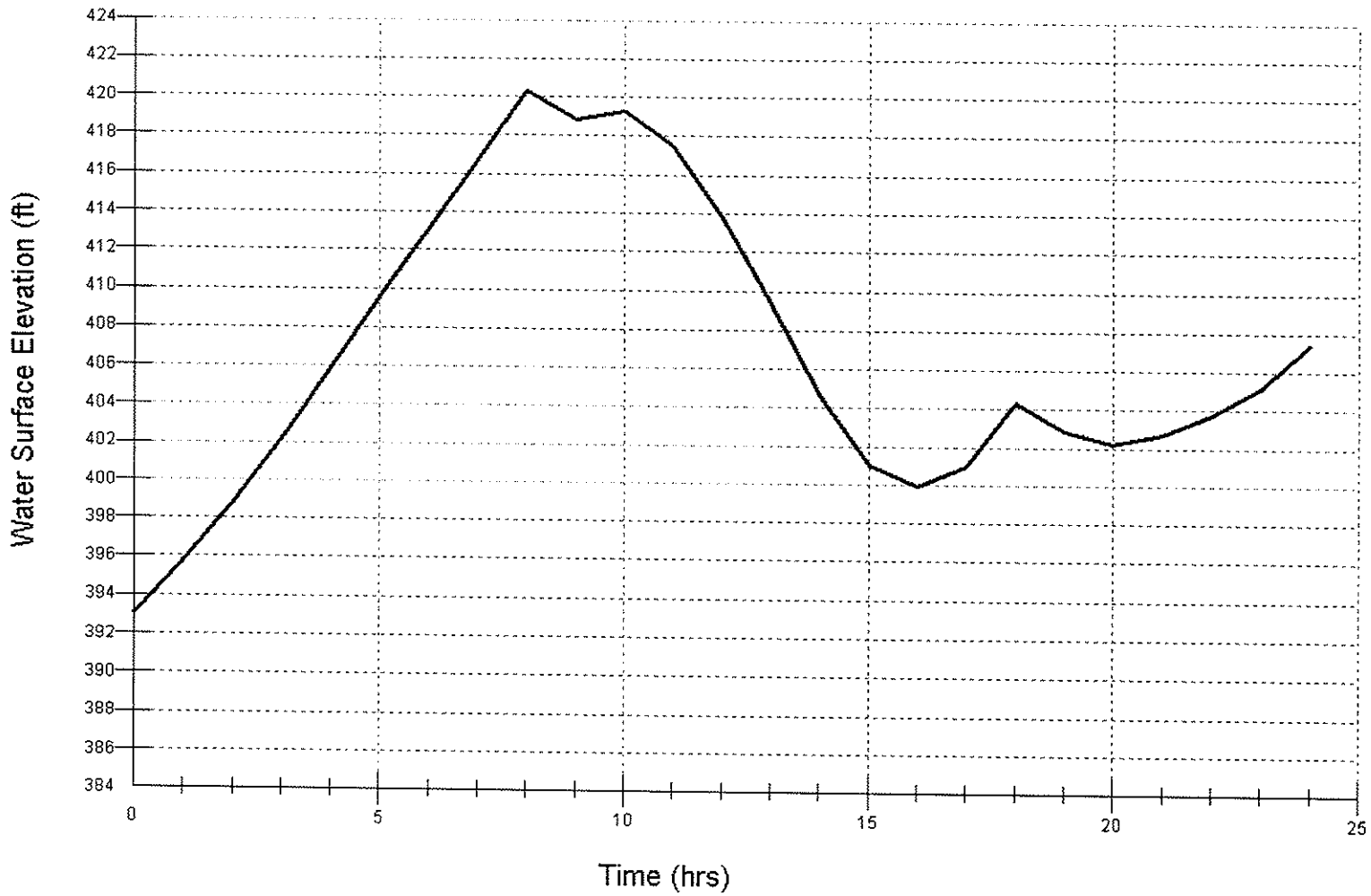


FIGURE 6-3
MAHR WATER LEVELS DURING ULTIMATE MAXIMUM DAY DEMAND SIMULATION

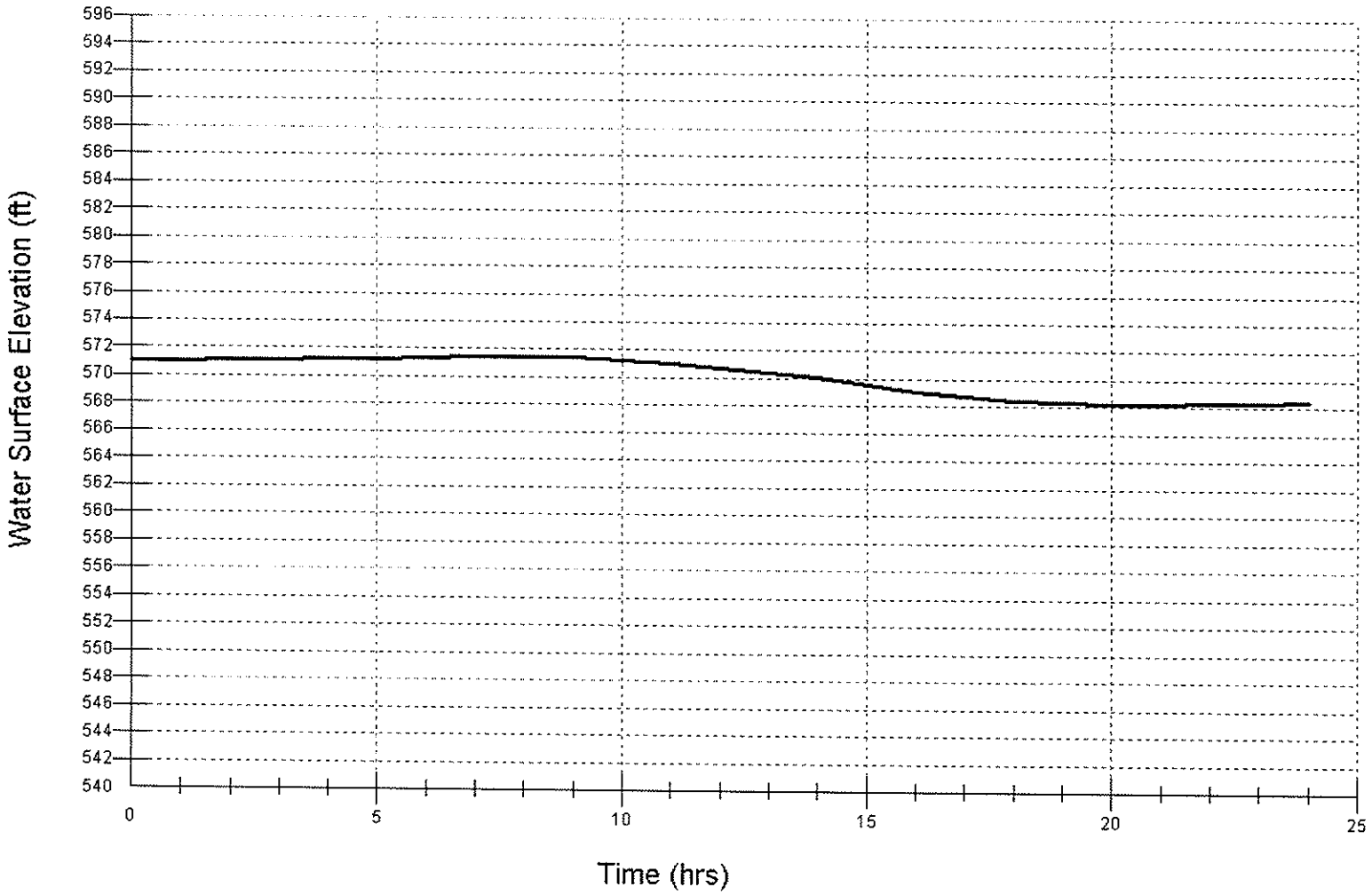


FIGURE 6-4
SANTA FE I TANK WATER LEVELS DURING ULTIMATE MAXIMUM DAY DEMAND SIMULATION

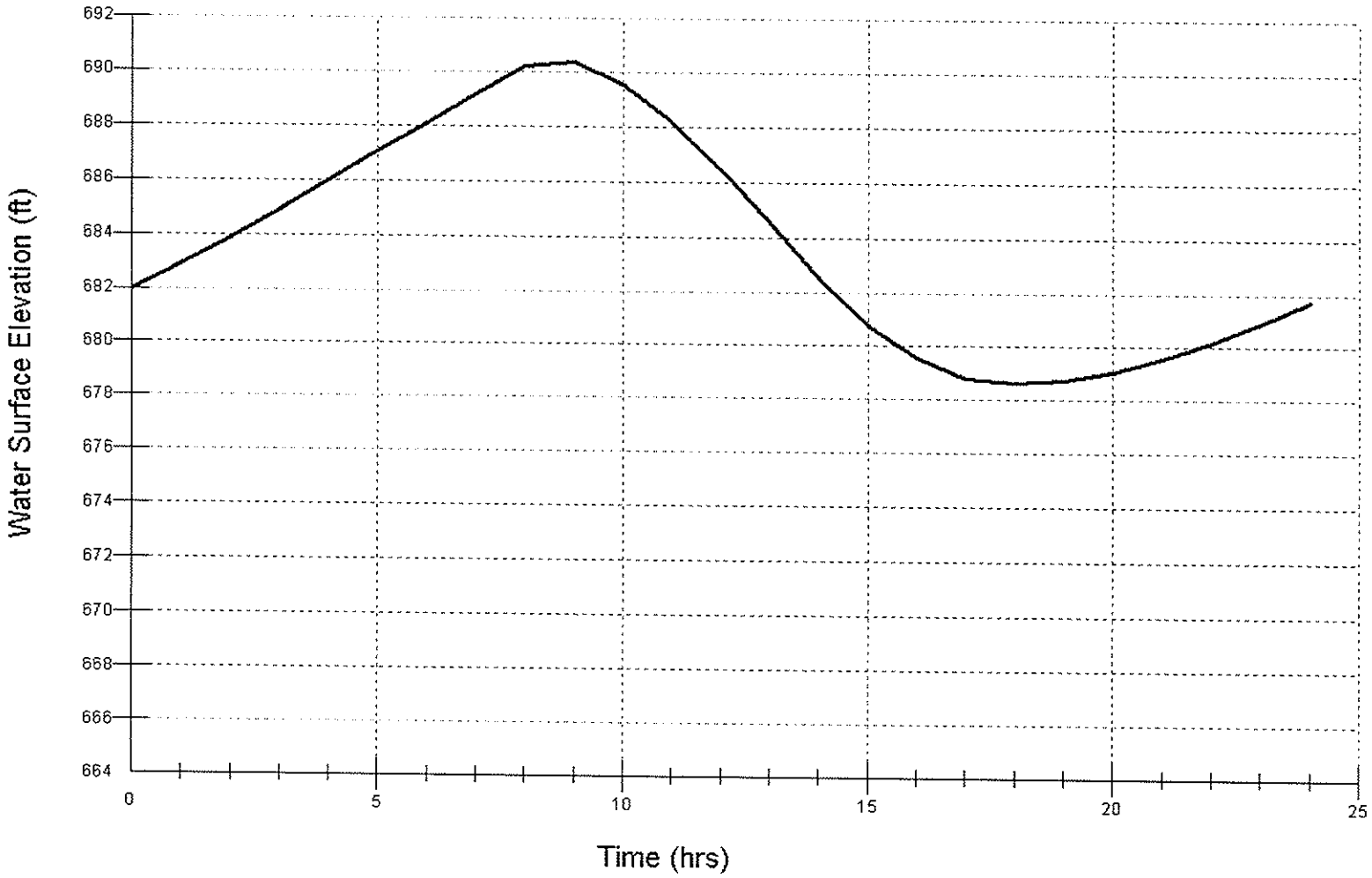
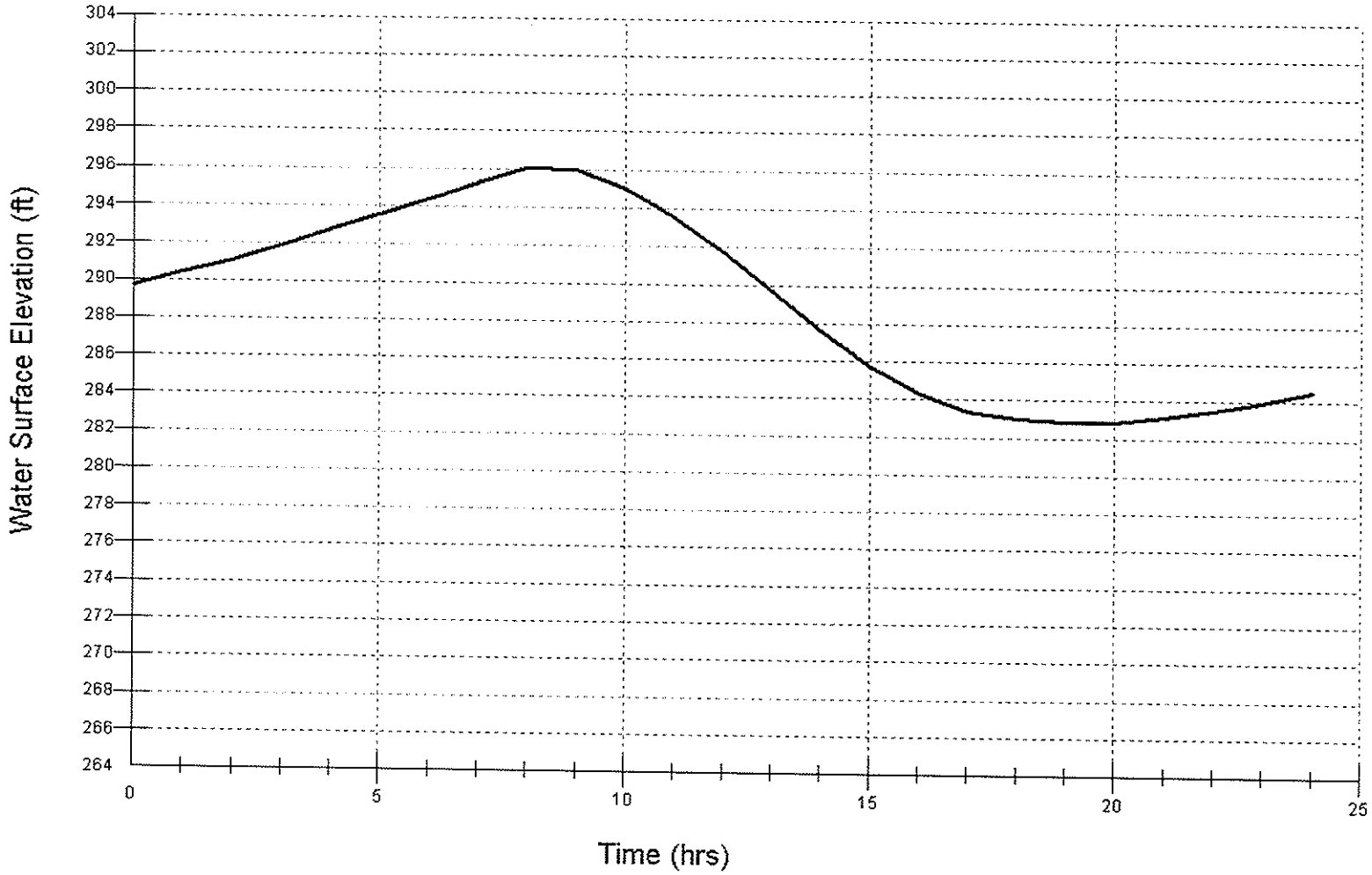


FIGURE 6-5
E TANK WATER LEVELS DURING ULTIMATE MAXIMUM DAY DEMAND SIMULATION



CHAPTER 7
CONCLUSIONS, RECOMMENDATIONS, AND IMPLEMENTATION

The following sections provide conclusions and recommendations regarding the planned Phase II expansion based on foregoing analysis and discussion. A final section provides a summary of steps needed to fully implement the Phase II expansion.

7.1 CONCLUSIONS

Demands

- In 1997, the Master Plan Update reviewed the previous assessment of potential reclaimed water markets. This assessment included 208 sites throughout the City, including Olivenhain Municipal Water District (OMWD) and projected an ultimate irrigation use of approximately 11,000 AFY.
- Based on billing account information provided by the District, approximately 120 meters are now supplied from the Phase I recycled water system. Average annual demand, calculated from 1998-99 billings, is 1,737 AFY or 1.55 MGD, excluding La Costa South Golf Course.
- For this study, approximately 850 potable irrigation meter accounts were surveyed from the District's existing records. The District currently serves approximately 3,300 AFY or 3 MGD of average annual irrigation demand with potable water, some of which can be converted to recycled water use in Phase II.
- Based on the potable water irrigation meter survey, the following areas within the District provide significant potential recycled water demand:
  - ❑ Carlsbad Research Center
  - ❑ Homeowner Associations just east of Interstate 5
  - ❑ Carrillo Ranch (Continental Homes)
  - ❑ District Office area
  - ❑ Calavera Hills

- The largest potential customers for the Phase II system are identified as follows:
  - ❑ Carlsbad Municipal Golf Course (385 AFY)
  - ❑ Kelly Ranch (216 AFY)
  - ❑ La Costa Residential Areas (170 AFY and 177 AFY)
  - ❑ Green Valley (155 AFY)
- The Phase II system is sized to serve a maximum potential recycled water demand of approximately 6,200 AFY within the City of Carlsbad, although the current Phase II re-use goal is 5,400 AFY.
- The Ultimate System will serve an additional 4,000 AFY of recycled water within the City of Carlsbad, for a total recycled demand approaching 10,000 AFY.

Supplies

- Existing recycled water demands currently exceed available recycled water supply during the summer and early fall, requiring supplemental potable water use.
- Based on the current recycled water supply rate of 1.7 MGD, it is estimated that approximately half the system demands for the peak month were supplied with potable water.
- Supplemental potable water is introduced to the recycled water system when the "D" Tanks reach a low water level. The potable water system pressure is usually sufficient to allow a flow rate to the "D" Tanks of about 2,000 gpm.
- Based on current planning, the combined recycled water supply for Phase II will include:
  - ❑ Gaffner WRP at 1.0 MGD
  - ❑ Meadowlark WRF at 2.0 MGD
  - ❑ Encina WPCF at 5.0 MGD

  It is estimated that the Phase II system will still require potable water supplement in the maximum month.

Facilities

- On the basis of foregoing analysis, the "D" Tanks are adequately sized to provide operational storage for existing demands, assuming the full tank volume can be used.

- Mahr Reservoir has an estimated useful capacity of 49 million gallons, which corresponds to a water surface elevation range of approximately 555 to 593 feet above mean sea level.
- Due to algae growth and hydrogen sulfide production in the reservoir, the District received numerous water quality complaints from customers, indicating remedial work was required for continued reservoir use.
- The Phase II recycled program requires the operation of transmission facilities and recycled service within the Olivenhain Municipal Water District (OMWD) service area of the City of Carlsbad.

7.2 RECOMMENDATIONS

- Mahr Reservoir can partially satisfy seasonal, operational, and emergency storage requirements for the Phase II expansion with some physical modifications to reduce or eliminate water quality concerns. The improvements recommended in this report should be constructed in a phased manner.
- Design the Phase II system for a potential demand greater than the reuse goal of 5,400 AFY to provide a contingency should some of the larger users not fully develop.
- The District should consider setting forth criteria that all new distribution facilities shall be designed to the peak hour of the average day of the maximum month, using 2.2 as maximum-month and 6.0 as peak-hour factors, respectively.
- Use the "D" Tanks as the primary hydraulic control of the Phase II distribution system.
- If the opportunity presents itself, the District should consider additional supply of recycled water or consider earlier phasing of the phased supplies currently planned.
- The District should pursue an operations agreement with OMWD to allow both supply and demands to be served within OMWD.
- The District should pursue the construction of both the source of recycled water at the Encina WPCF and the forebay reservoir to be constructed in phases up to 8.0 MG to allow successful operation of the tertiary filters and the distribution system.

7.3 IMPLEMENTATION

The District is currently completing Phase II expansion environmental documentation, preliminary design, and an agreement with MWD through their LRP for partial facility funding. The District has initiated preparation of a funding request from the State Water Resources Control Board (SWRCB) through one of their low-interest loan programs for additional capital funding. The following steps should be undertaken to fully implement the Phase II expansion:

- Continue pursuing an SWRCB low-interest loan and satisfying the MWD LRP milestones.
- Initiate design for the most critical and/or longest-lead facilities. Based on a preliminary review, those items include:
  - ❑ "D" Tank Pump Station
  - ❑ Alga Road 24-inch transmission main
  - ❑ Mahr Reservoir improvements
- Complete all applicable regulatory requirements that affect recycled water production, storage, distribution, and end use.
- Immediately address all institutional requirements that can constrain the phased expansion of the system, including an agreement with Vallecitos Water District for improvements to and long-term use of Mahr Reservoir for storage, and an agreement with Encina Water Authority for tertiary effluent production and related modifications to Encina WPCF.
- Complete all internal requirements imposed by the expansion, including adequate staffing for design and construction review and coordination, customer connection and coordination, and regulatory/institutional coordination; and adequate system monitoring to ensure ongoing refinement of preliminary design assumptions.
- Initiate construction for most critical and/or longest-lead facilities, including compliance with MWD's LRP and SWRCB's low-interest loan requirements.